# EXHIBIT 6

## FILED UNDER SEAL

## 2 of 2

340. I understand that Sonos does not dispute that Squeezebox discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Squeezebox. I have reviewed Sonos's response ("Validity Contentions") as it relates to Squeezebox and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 85-86.

*(iv) Limitation 1.3: "a non-transitory computer-readable medium; and"*

341. In my opinion, the Sonos System discloses this claim limitation. For example, Squeezebox stores on a non-transitory computer-readable medium firmware that it executes. Squeezebox also remembers network settings in the non-transitory computer-readable medium, which was apparent in my testing of the device.

**I'm having trouble upgrading the firmware on Squeezebox2. Do you have any hints?**

If Squeezebox2 is connected to the SlimServer software, you can press and hold the BRIGHTNESS button on the remote for 5 seconds to start the upgrade process.

**Original Squeezebox Note:**

If the firmware upgrade failed and the display reads "Ready to update this Squeezebox2" and indicates the IP address for the player, then you can open up this URL: http://localhost:9000/firmware.html. This page will have a place for you to enter the IP address displayed on Squeezebox. Click Submit to begin the upgrade process.

If the firmware on Squeezebox is corrupted, it may be reset to the IP address "192.168.1.69". If this happens AND the IP address of the computer running the SlimServer software does not begin with 192.168.1, you may need to change the network settings temporarily on the SlimServer computer to an IP address that does, such as 192.168.1.65, in order to peform the firmware update.

**I'm having trouble upgrading the firmware on my SLIMP3 Player. Do you have any hints?**

Try following these steps:

1. Plug the SLIMP3 device and the computer with the updater into the same hub or switch. (Do not attempt to upgrade your firmware over a wireless network.) Power the hub or switch off and then back on.
2. Remove the power connector from the back of the SLIMP3 device.
3. Stop the SlimServer software.
4. Run a browser and check that the SlimServer software has REALLY stopped.
5. Point the remote at the right side of the SLIMP3, hold down a numeric key, and reconnect the power plug to the SLIMP3. You should see the SLIMP3 display its MAC address. If not then unplug the DC power connector from the device, wait 30 seconds and t ry this operation again. The SLIMP3 device MUST be displaying its MAC address before you can update the firmware. Write down the MAC address that the SLIMP3 is showing.
6. Start the updater application:
   - On Windows, the SLIMP3 Updater is in Program Files\SlimServer\firmware.
   - Mac users can find the SLIMP3 Updater application in the Utilities folder of the SlimServer installer disk image.
   - On Linux, the firmware updater is /usr/local/bin/slimserver/slimp3/update_firmware.pl.
7. You will be prompted to enter the SLIMP3 MAC address in the form 00:04:20:xx:xx:xx - enter the exact same MAC address that the sliMP3 displayed in (5) at the updater prompt.
8. The updater will then ask for an IP address so enter the IP address that you have assigned to the SLIMP3 device or, if you have a DHCP server, then enter an address in the DHCP pool.
9. The updater may ask if you want to use "Kiosk" - you answer with "y" or "N". Use "N" if you are having problems getting the SLIMP3 running - use the Kiosk mode once everything is working.
10. The updater will immediately start trying to update the SLIMP3 device at this point-this will take about 30 seconds.

IA at 84.

342. As discussed further below, I describe how Squeezebox receives digital indications regarding group assignment, synchronization, and other issues. This further confirms my opinions that Squeezebox discloses this claim element because the Squeezebox necessarily processes this information and stores it in order to operate responsively.

343. I understand that Sonos does not dispute that Squeezebox discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Squeezebox. I have reviewed

Sonos's response ("Validity Contentions") as it relates to Squeezebox and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 85-86.

*(v) Limitation 1.4: "program instructions stored on the non-transitory computer-readable medium that, when executed by the one or more processors, cause the first zone player to perform functions comprising:"*

344. In my opinion, Squeezebox discloses this claim limitation.

345. For the reasons stated above with respect to Limitations 1.2 and 1.3, Squeezebox includes program instructions stored on the non-transitory medium that when executed by the processors perform the functions discussed in the following claim limitations, as described below. Squeezebox may be programmed and updated, and once programmed and/or updated, Squeezebox may execute the instructions that are stored on the Squeezebox.

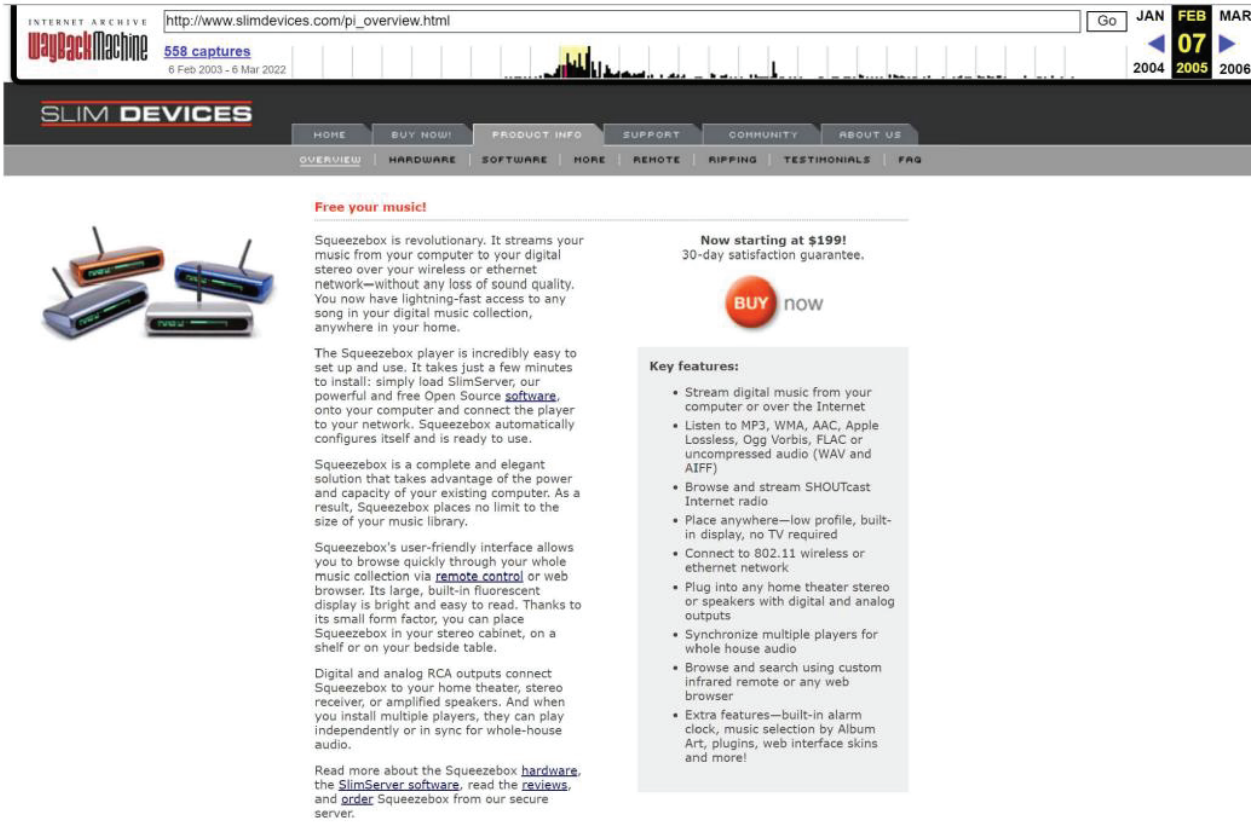
346. I understand that Sonos does not dispute that Squeezebox discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Squeezebox. I have reviewed Sonos's response ("Validity Contentions") as it relates to Squeezebox and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 85-86.

*(vi) Limitation 1.5: "while operating in a standalone mode in which the first zone player is configured to play back media individually in a networked media playback system comprising the first zone player and at least two other zone players:"*

347. In my opinion, Squeezebox discloses this claim limitation.

348. I note that Sonos has taken a position during its summary judgment briefing regarding what disclosure is adequate to disclose "standalone" mode. As discussed *supra* in Section X, Sonos essentially argues that the mere ability of the Zone Player to output audio discloses the "standalone" mode. *E.g.*, '885 Pat at 5:21-6:27 ("when an audio source is retrieved via the network interface 202, the audio source is processed in the audio processing circuit 210 to produce analog audio signals. The processed analog audio signals are then provided to the audio amplifier 214 for playback on speakers.").

349. The Squeezebox performs the same function, and it can operate independently from other Squeezeboxes and output audio to speaker systems.




IA at 61.

# Playing Your Music

Squeezebox2 plays music that you select with the remote control or the web interface.

## Using the Remote to Play Music

1. Use the **LEFT** arrow to go to **`Squeezebox Home`**. You may have to press the **LEFT** arrow more than once to get there.
2. Use the **UP** and **DOWN** arrows to find the **`Browse Music`** option.
3. Press the **RIGHT** arrow. The **`Browse Albums`** option is displayed. You can scroll down to browse by artist or genre, new music, existing playlists, or browse the contents of your music folder.
4. To browse an album, artist, or genre, press the **RIGHT** arrow to select it, then the **UP** and **DOWN** arrows to scroll through the list.
5. When you find an album, artist, genre or song you want to listen to, press **PLAY** to play all the songs associated with the displayed item.

   **Hint:** If you want to play the selected songs after the songs that you are already listening to, press **ADD** and they will be added to the end of the list.
6. Press **NOW PLAYING** to jump to the list of songs that you have selected to play. Scroll through the list with the **UP** and **DOWN** arrows. Press the **LEFT** arrow to return to the main **`Squeezebox Home`** menu.

## Using the Web Interface to Play Music

1. Open the web interface in your browser.

   If you are using the computer where you installed SlimServer, go to *http://localhost:9000*

   If you are using a different computer on the same local network as the SlimServer computer, use *"http://<IPaddress>:9000"* where <IPaddress> is the IP address or name of the SlimServer computer. See the Troubleshooting section at the end of this guide for details.

**Hint:** Windows users can use the SlimServer application to bring up the web interface automatically on their SlimServer computer. Mac users

Squeezebox 2 Owner's guide at 13 (http://svn.slimdevices.com/repos/slim/7.4/trunk/docs/squeezebox2/Squeezebox2-Owners-Guide.pdf).

## Playing Your Music

Squeezebox plays music that you select with the remote control or the web interface.

### Using the Remote to Play Music

1. Use the **LEFT** arrow to go to Squeezebox Home. You may have to press the **LEFT** arrow more than once to get there.
2. Use the **UP** and **DOWN** arrows to find the Browse Music option.
3. Press the **RIGHT** arrow. The Browse Albums option is displayed. You can scroll down to browse by artist, genre, year, new music, existing playlists, or browse the contents of your music folder.
4. To browse an album, artist, or genre, press the **RIGHT** arrow to select it, then the **UP** and **DOWN** arrows to scroll through the list.
5. When you find an album, artist, genre or song you want to listen to, press **PLAY** to play all the songs associated with the displayed item.

**Tip:** If you want to play the selected songs after the songs that you are already listening to, press **ADD** and they will be added to the end of the list.

6. Press **NOW PLAYING** to jump to the list of songs that you have selected to play. Scroll through the list with the **UP** and **DOWN** arrows. Press the **LEFT** arrow to return to the main Squeezebox Home menu.

### Using the Web Interface to Play Music

1. Open the web interface in your browser.

   If you are using the computer where you installed SlimServer, go to *http://localhost:9000/*

   If you are using a different computer on the same local network as the SlimServer computer, use *"http://<IPaddress>:9000/"* where <IPaddress> is the IP address or name of the SlimServer computer. See the Troubleshooting section at the end of this guide for details.

**Tip:** Windows users can use the SlimServer System Tray icon to bring up the web interface automatically on their SlimServer computer.

Squeezebox 3 Owner's Guide at 12 (http://svn.slimdevices.com/repos/slim/7.4/trunk/docs/squeezebox3/Squeezebox-v3-Owners-Guide.pdf).

350. As Sonos argued in its MSJ briefing (quoted above), the fact that the Sonos documentation does not include the term "standalone mode" does not prevent it from disclosing "standalone mode." Sonos further argued that "standalone mode" is disclosed by the '885 Patent regardless of whether the disclosed Zone Players are actively playing back music—in other words, just the fact that they exist and have the ability to play back music is sufficient. This is likewise

disclosed by Squeezebox because it can or may not play back music, as shown above.

351. As shown above and discussed in more detail below, a Squeezebox or Softsqueeze can play back media individually. There may be multiple Squeezeboxes or Softsqueezes operating on the network at the same time. *E.g.*, IA at 74 ("Yes, you can have any number of Squeezeboxes on your LAN"), 99, 312.

*(vii) Limitation 1.6: "(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked; and"*

352. In my opinion, the Sonos System discloses this claim limitation.

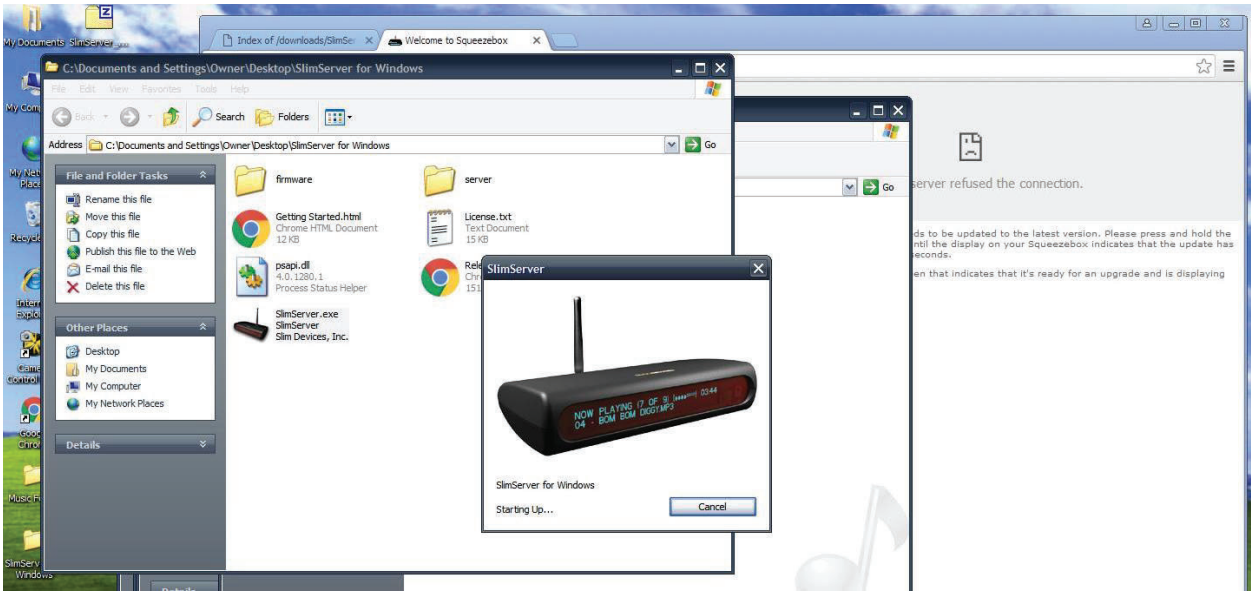
353. Sonos discussed this claim limitation, in part, in its summary judgment briefing. As I discussed *supra* in Section X, Sonos argued that adding a speaker to a speaker group via a controller and sending an "indication" that need not include the "zone scene" or the players in that zone scene is sufficient to meet this claim limitation.

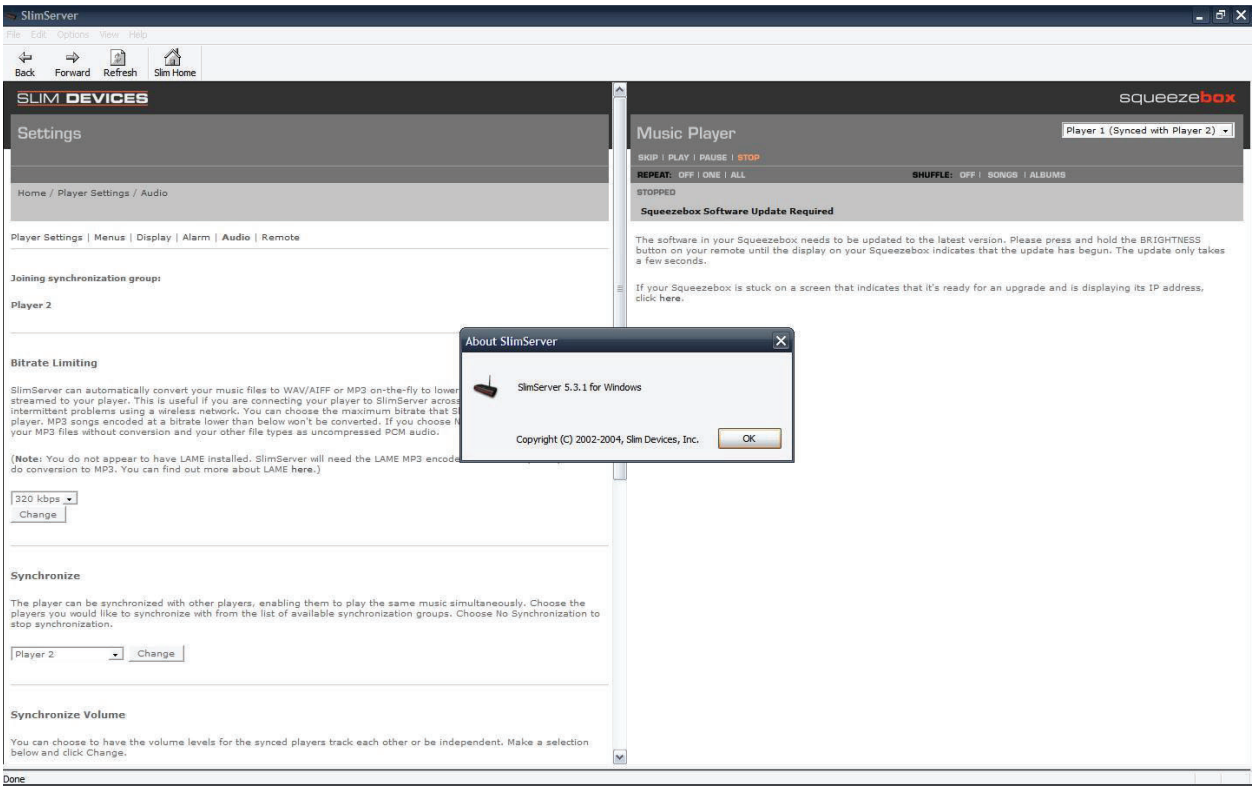
354. Squeezebox discloses this behavior. The claim limitation requires the Squeezebox to receive information from a network device over a data network. The network device may comprise the SlimServer running on a computer, which allows a user to control Squeezeboxes remotely over Wi-Fi or wired data networks. Squeezebox receives a first indication in the form of network messages passed from the controller and that later permit the Squeezebox to synchronously playback media with other Squeezeboxes when the named group of Squeezeboxes is invoked by selecting that "zone scene" for synchronous playback.

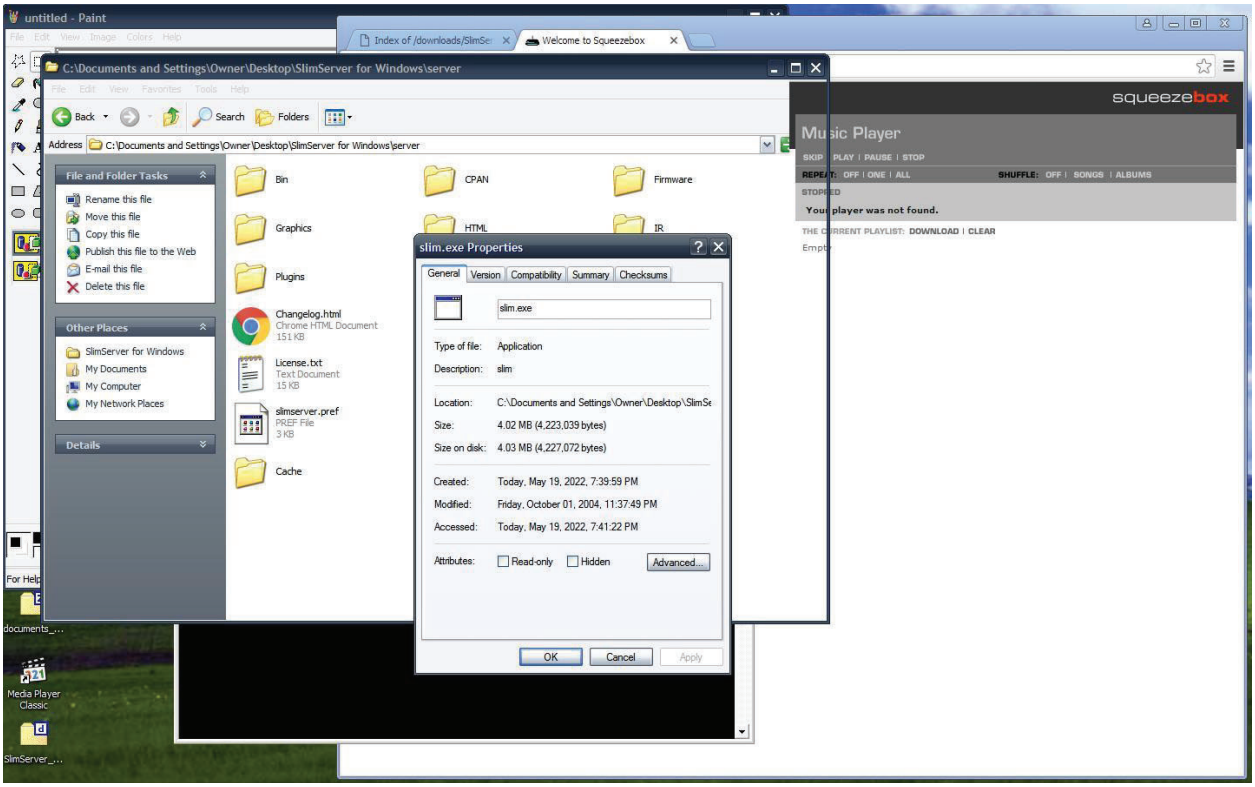
355. I have provided below screenshots of certain testing performed on physical

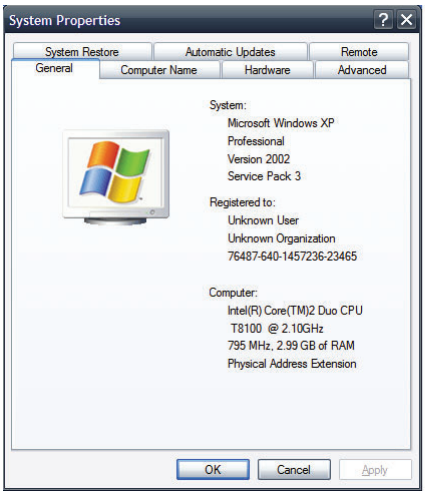
Squeezeboxes. This testing was performed on SlimServer version 5.3.1, which was available October 2004, and I have confirmed that other versions operate similarly. https://downloads.slimdevices.com/; https://downloads.slimdevices.com/SlimServer_v5.3.1/. The testing was performed with a prior art laptop running prior art operating system software made available for inspection to Sonos.

| Name | Type | Compressed size | Password ... | Size | Ratio | Date modified |
|---|---|---|---|---|---|---|
| firmware | File folder | | | | | 10/1/2004 2:37 PM |
| server | File folder | | | | | 10/1/2004 2:37 PM |
| Getting Started.html | Chrome HTML Document | 4 KB | No | 12 KB | 64% | 10/1/2004 2:37 PM |
| License.txt | Text Document | 6 KB | No | 15 KB | 62% | 10/1/2004 2:37 PM |
| psapi.dll | Application extension | 23 KB | No | 45 KB | 49% | 10/1/2004 2:37 PM |
| Release Notes.html | Chrome HTML Document | 49 KB | No | 151 KB | 68% | 10/1/2004 2:37 PM |
| SlimServer.exe | Application | 230 KB | No | 512 KB | 56% | 10/1/2004 2:37 PM |

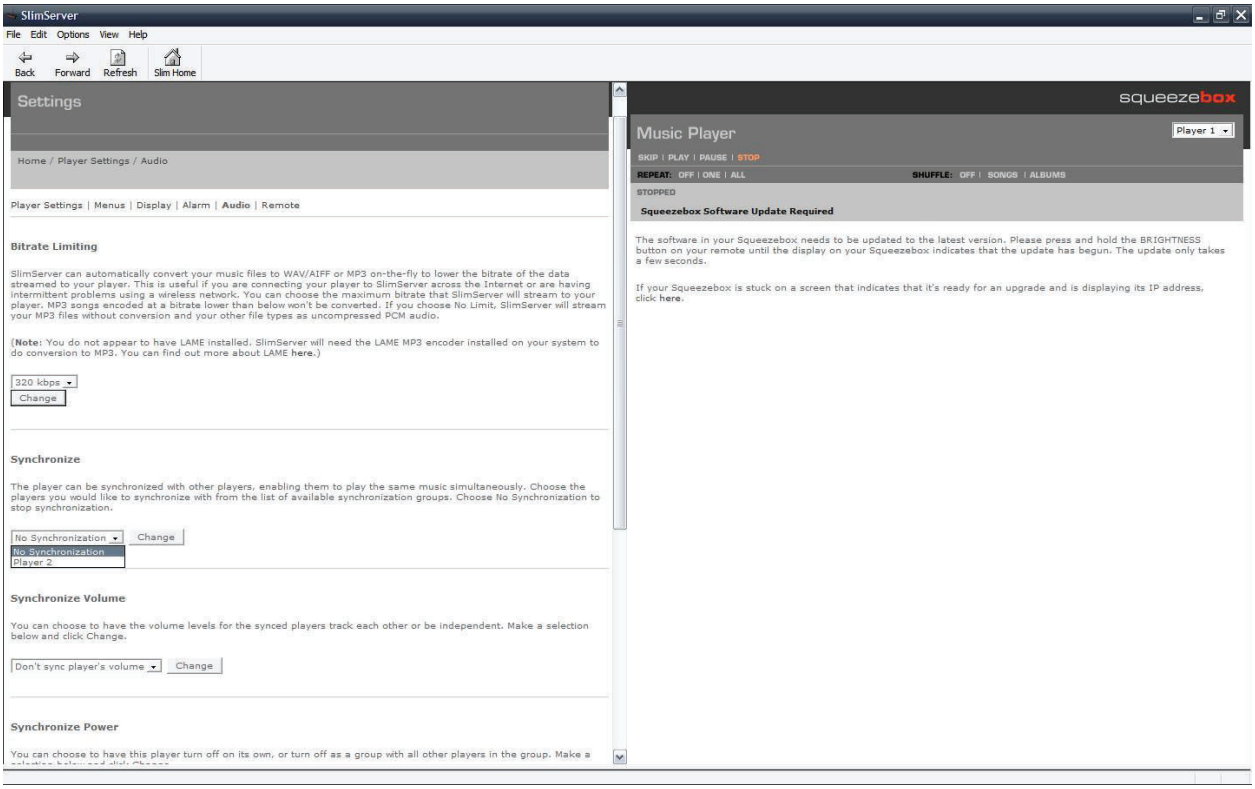


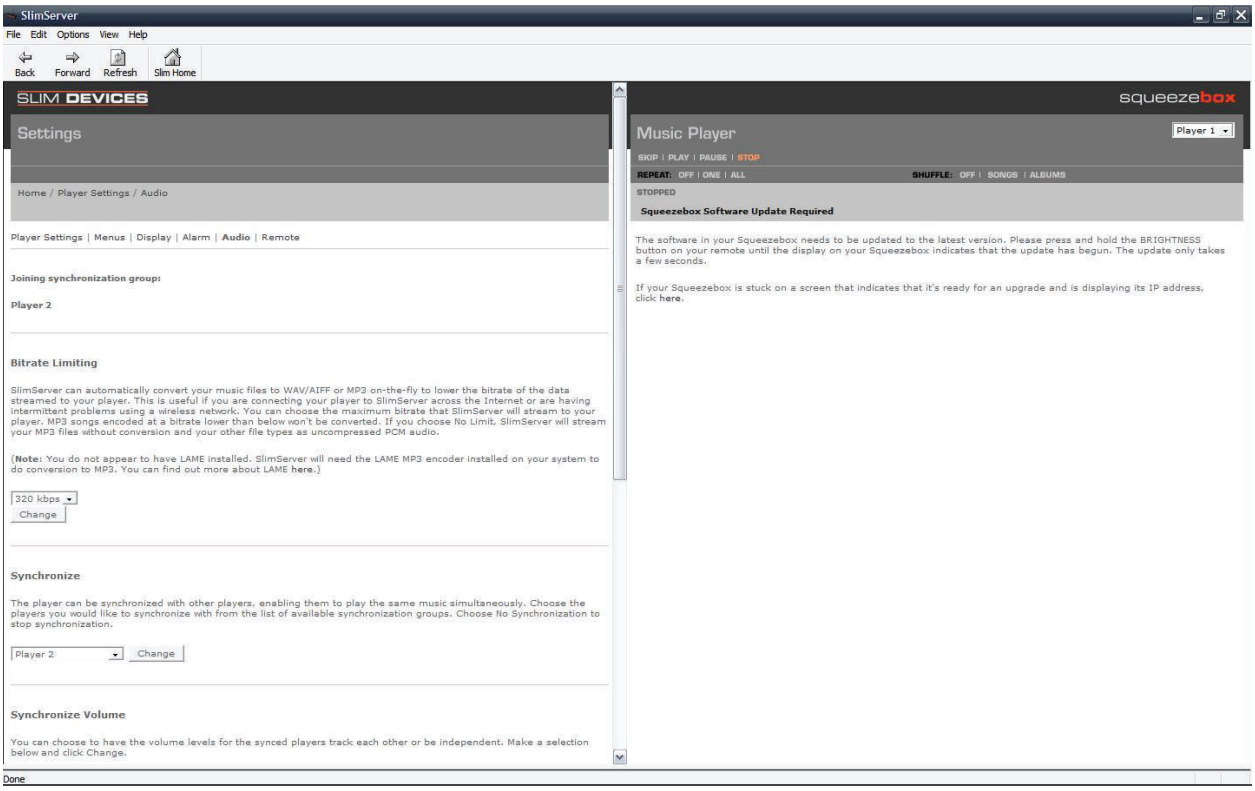

SlimServer
Back
Forward
Refresh
Slim Home
SLIM DEVICES
Settings
Home / Player Settings / Audio
Player Settings | Menus | Display | Alarm | Audio | Remote
Joining synchronization group:
Player 2
Bitrate Limiting
320 kbps
Change
Synchronize
Player 2
Change
Synchronize Volume
squeezebox
Music Player
Player 1 (Synced with Player 2)
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
About SlimServer
SlimServer 5.3.1 for Windows
Copyright (C) 2002-2004, Slim Devices, Inc.
OK
Done

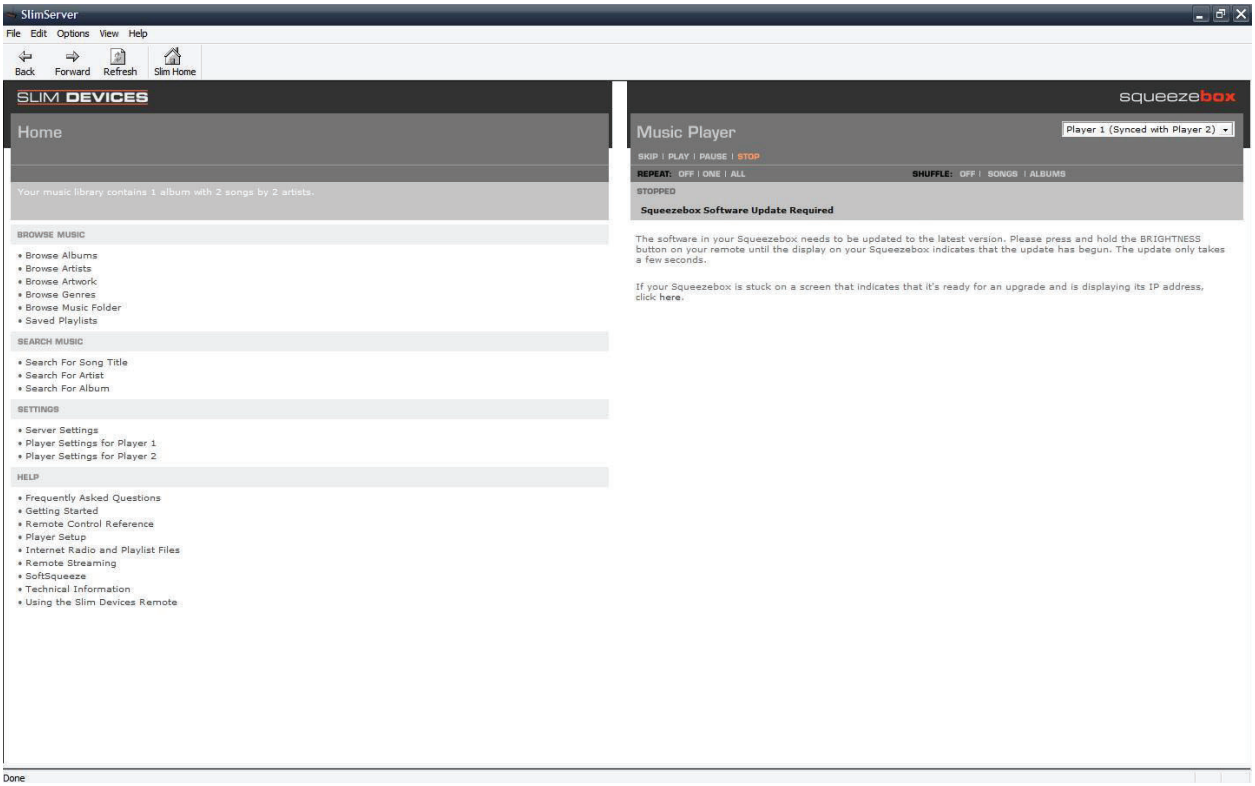

untitled - Paint
Welcome to Squeezebox
C:\Documents and Settings\Owner\Desktop\SlimServer for Windows\server
Address
File and Folder Tasks
Other Places
Details
Bin
CPAN
Firmware
Graphics
HTML
IR
Plugins
Changelog.html
License.txt
slimserver.pref
Cache
slim.exe Properties
General
Version
Compatibility
Summary
Checksums
Type of file: Application
Description: slim
Location:
Size: 4.02 MB (4,223,039 bytes)
Size on disk: 4.03 MB (4,227,072 bytes)
Created: Today, May 19, 2022, 7:39:59 PM
Modified: Friday, October 01, 2004, 11:37:49 PM
Accessed: Today, May 19, 2022, 7:41:22 PM
Attributes: Read-only Hidden Advanced...
OK
Cancel
Apply
squeezebox
Music Player
Your player was not found.

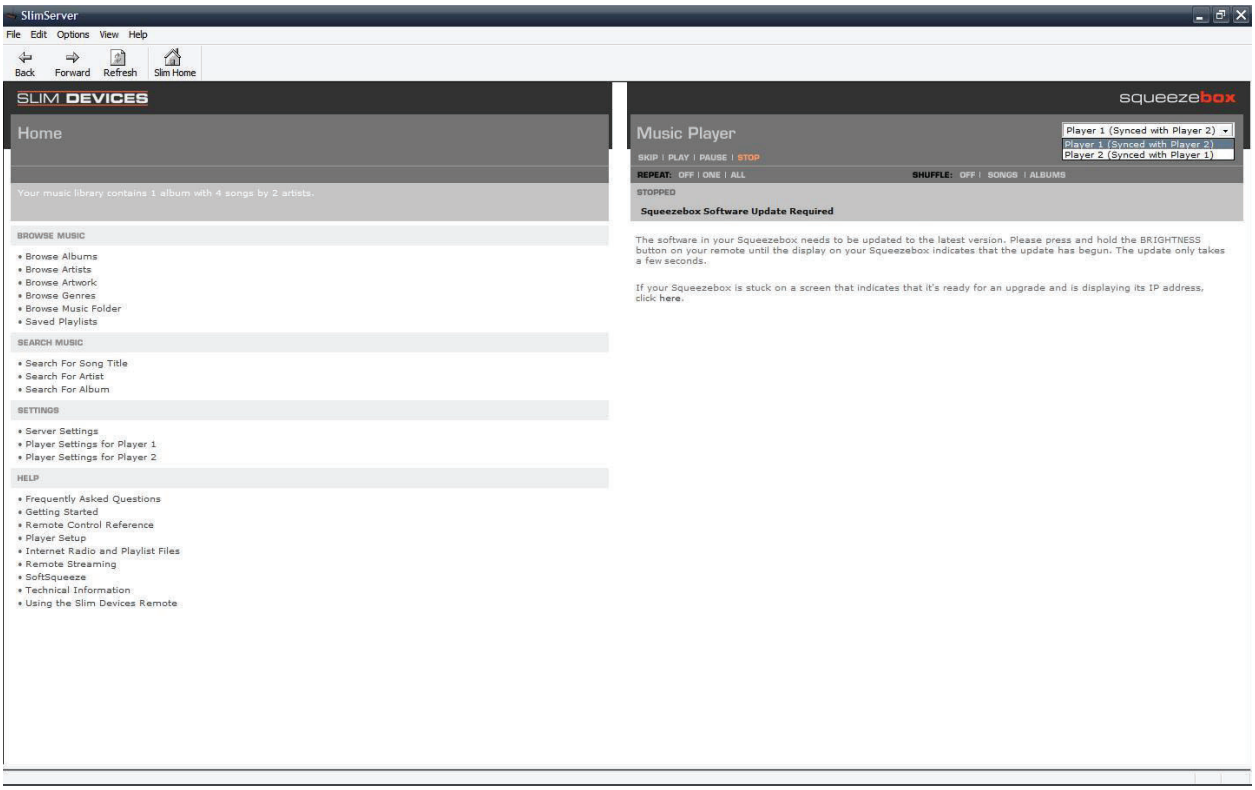



356. As shown below, the SlimServer allows a user to group together different Squeezebox and Softsqueeze players so that synchronous playback is performed.

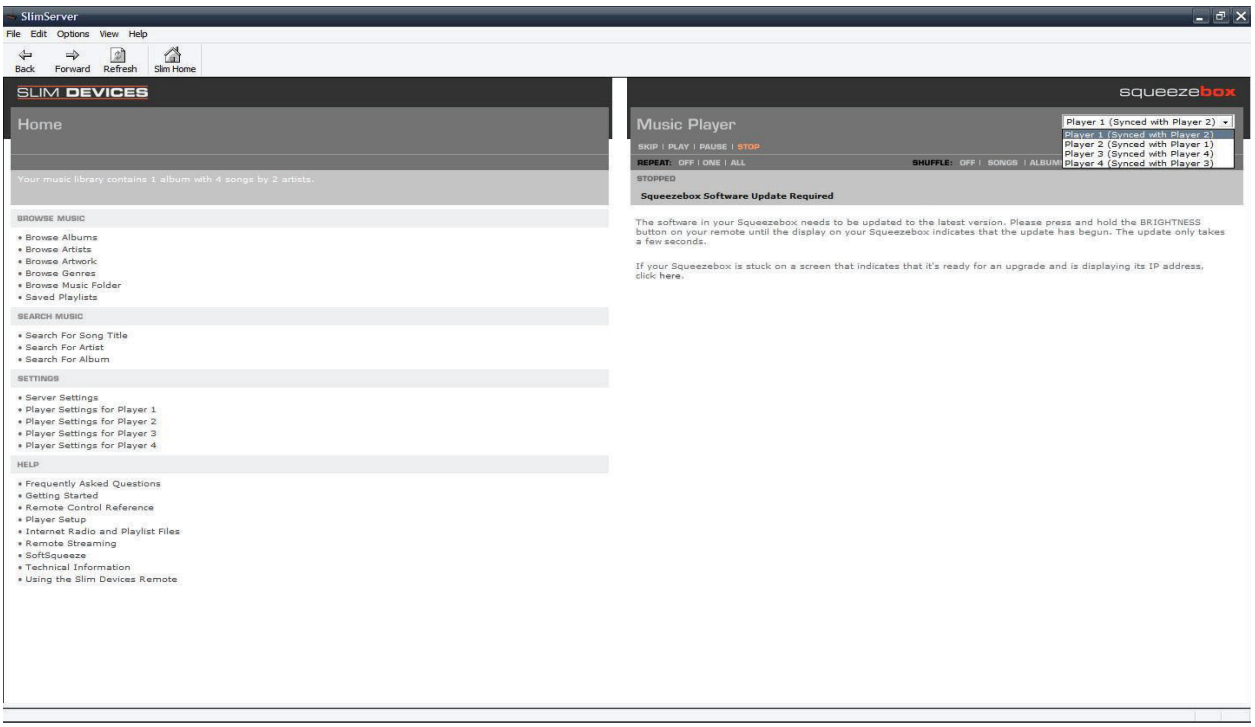



SlimServer
File Edit Options View Help
Back Forward Refresh Slim Home
SLIM DEVICES
Settings
Home / Player Settings / Audio
Player Settings | Menus | Display | Alarm | Audio | Remote
Joining synchronization group:
Player 2
Bitrate Limiting
SlimServer can automatically convert your music files to WAV/AIFF or MP3 on-the-fly to lower the bitrate of the data streamed to your player. This is useful if you are connecting your player to SlimServer across the Internet or are having intermittent problems using a wireless network. You can choose the maximum bitrate that SlimServer will stream to your player. MP3 songs encoded at a bitrate lower than below won't be converted. If you choose No Limit, SlimServer will stream your MP3 files without conversion and your other file types as uncompressed PCM audio.
(Note: You do not appear to have LAME installed. SlimServer will need the LAME MP3 encoder installed on your system to do conversion to MP3. You can find out more about LAME here.)
320 kbps
Change
Synchronize
The player can be synchronized with other players, enabling them to play the same music simultaneously. Choose the players you would like to synchronize with from the list of available synchronization groups. Choose No Synchronization to stop synchronization.
Player 2
Change
Synchronize Volume
You can choose to have the volume levels for the synced players track each other or be independent. Make a selection below and click Change.
squeezebox
Music Player
Player 1
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
The software in your Squeezebox needs to be updated to the latest version. Please press and hold the BRIGHTNESS button on your remote until the display on your Squeezebox indicates that the update has begun. The update only takes a few seconds.
If your Squeezebox is stuck on a screen that indicates that it's ready for an upgrade and is displaying its IP address, click here.
Done

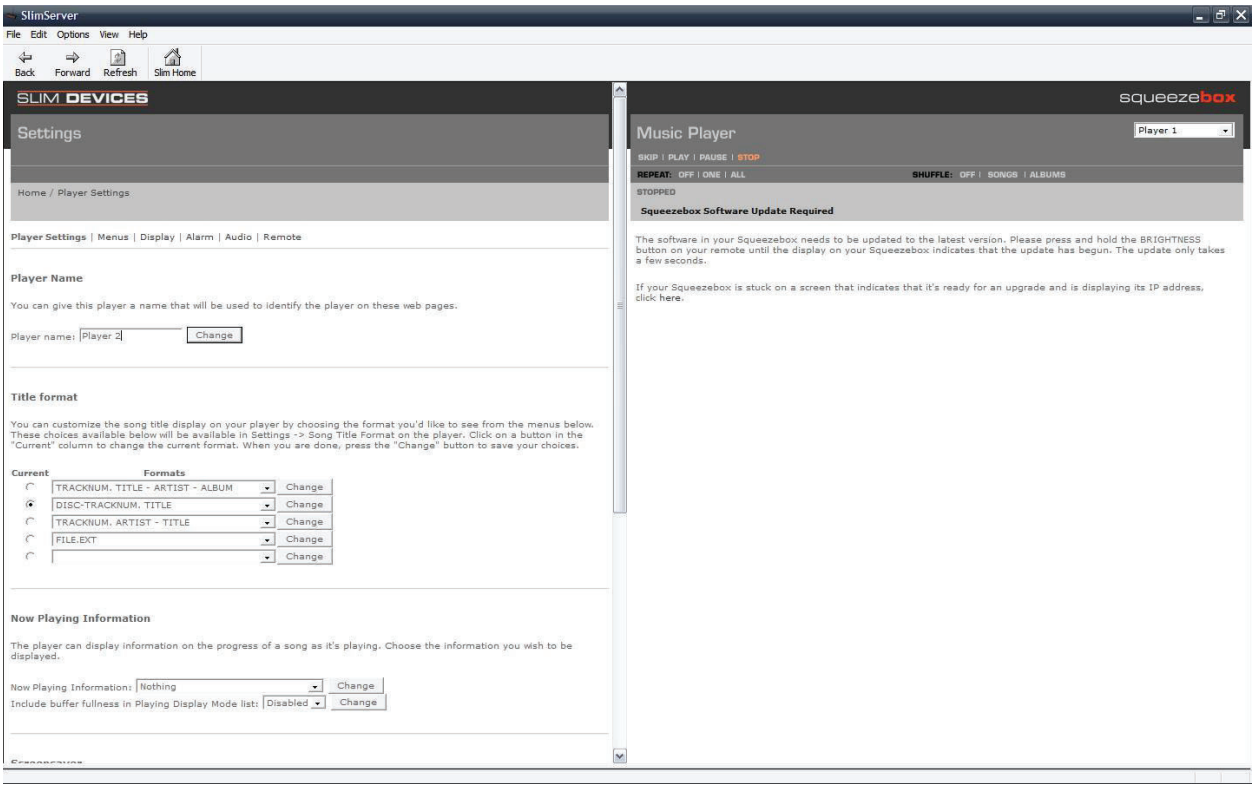

SlimServer
File Edit Options View Help
Back Forward Refresh Slim Home
SLIM DEVICES
Home
Your music library contains 1 album with 2 songs by 2 artists.
BROWSE MUSIC
• Browse Albums
• Browse Artists
• Browse Artwork
• Browse Genres
• Browse Music Folder
• Saved Playlists
SEARCH MUSIC
• Search For Song Title
• Search For Artist
• Search For Album
SETTINGS
• Server Settings
• Player Settings for Player 1
• Player Settings for Player 2
HELP
• Frequently Asked Questions
• Getting Started
• Remote Control Reference
• Player Setup
• Internet Radio and Playlist Files
• Remote Streaming
• SoftSqueeze
• Technical Information
• Using the Slim Devices Remote
squeezebox
Music Player
Player 1 (Synced with Player 2)
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
The software in your Squeezebox needs to be updated to the latest version. Please press and hold the BRIGHTNESS button on your remote until the display on your Squeezebox indicates that the update has begun. The update only takes a few seconds.
If your Squeezebox is stuck on a screen that indicates that it's ready for an upgrade and is displaying its IP address, click here.
Done



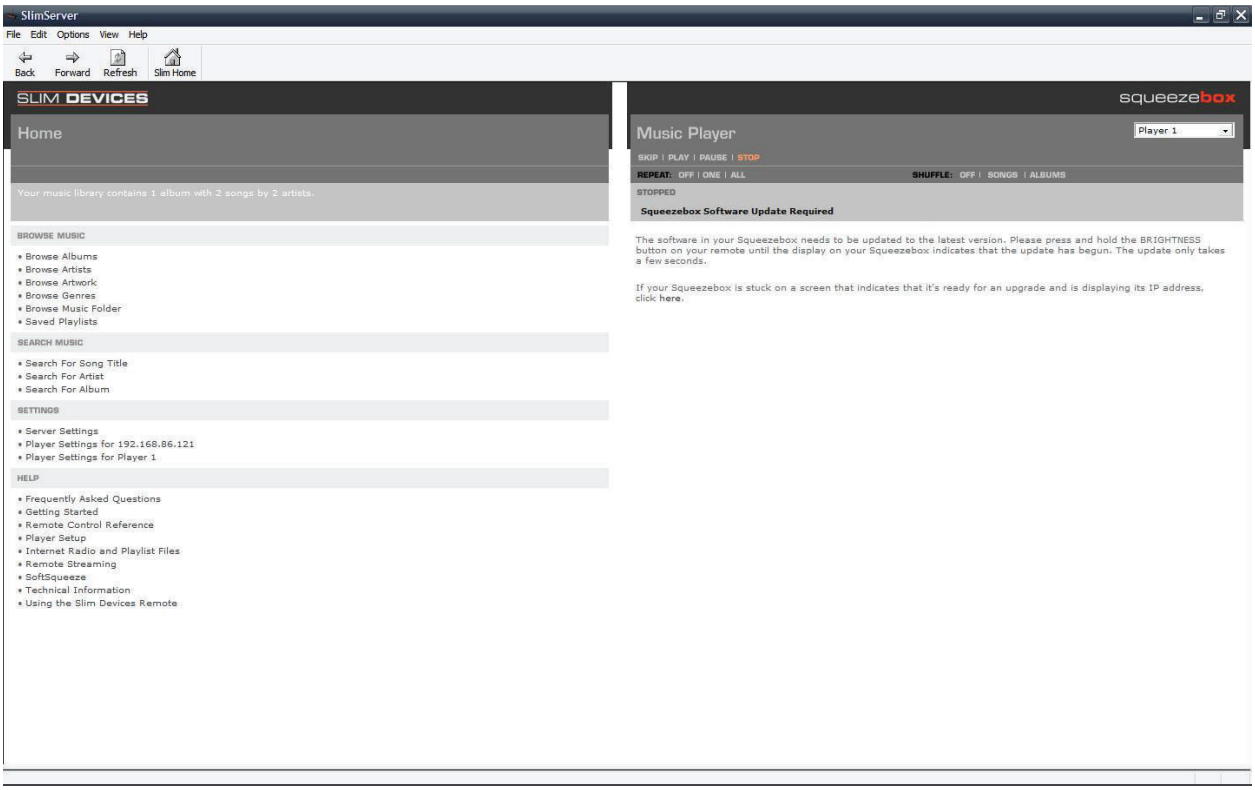

357. This version of the Slim Server allows the user to group Squeezeboxes, such as grouping Player 1 with Player 2 and Player 3 with Player 4.



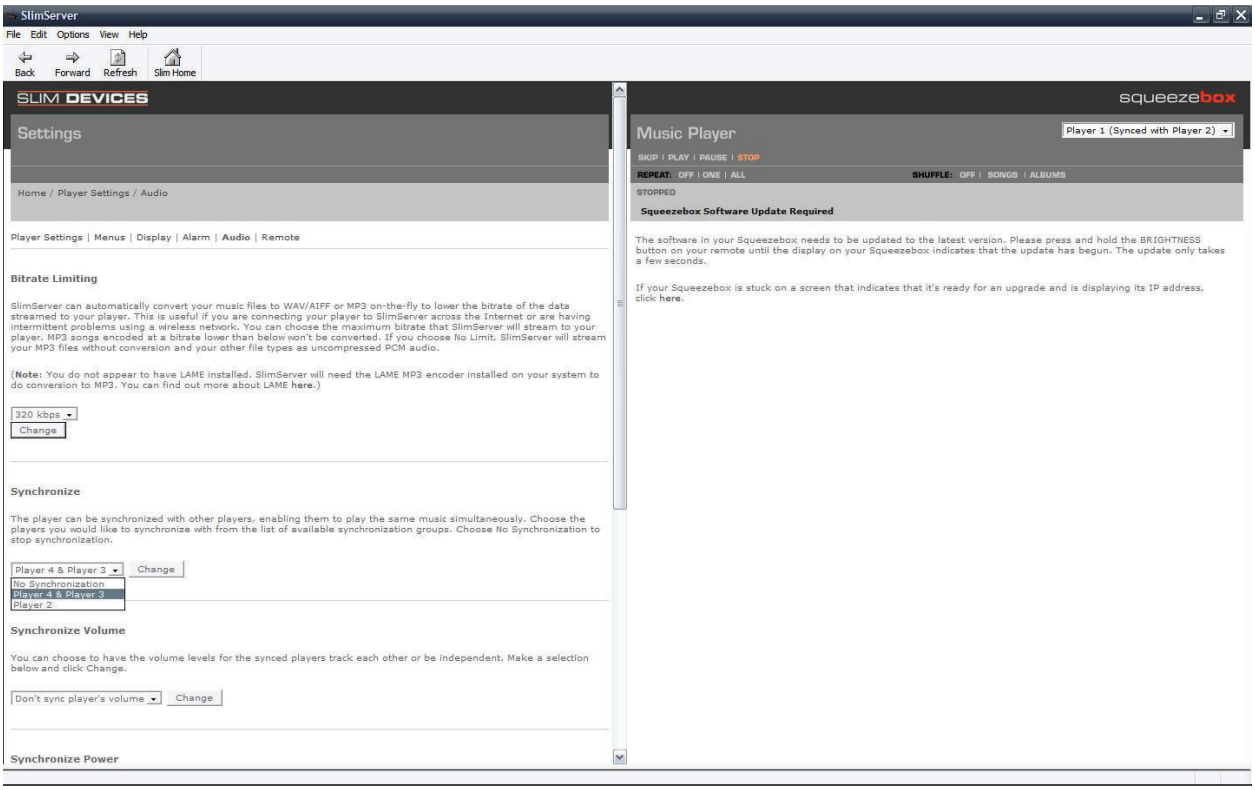
358. The user of Slim Server may change the name and identifiers of the Squeezebox devices, which in turn changes the name of the grouped Squeezebox devices. The Squeezebox devices may be played to individually or as a group.[4]

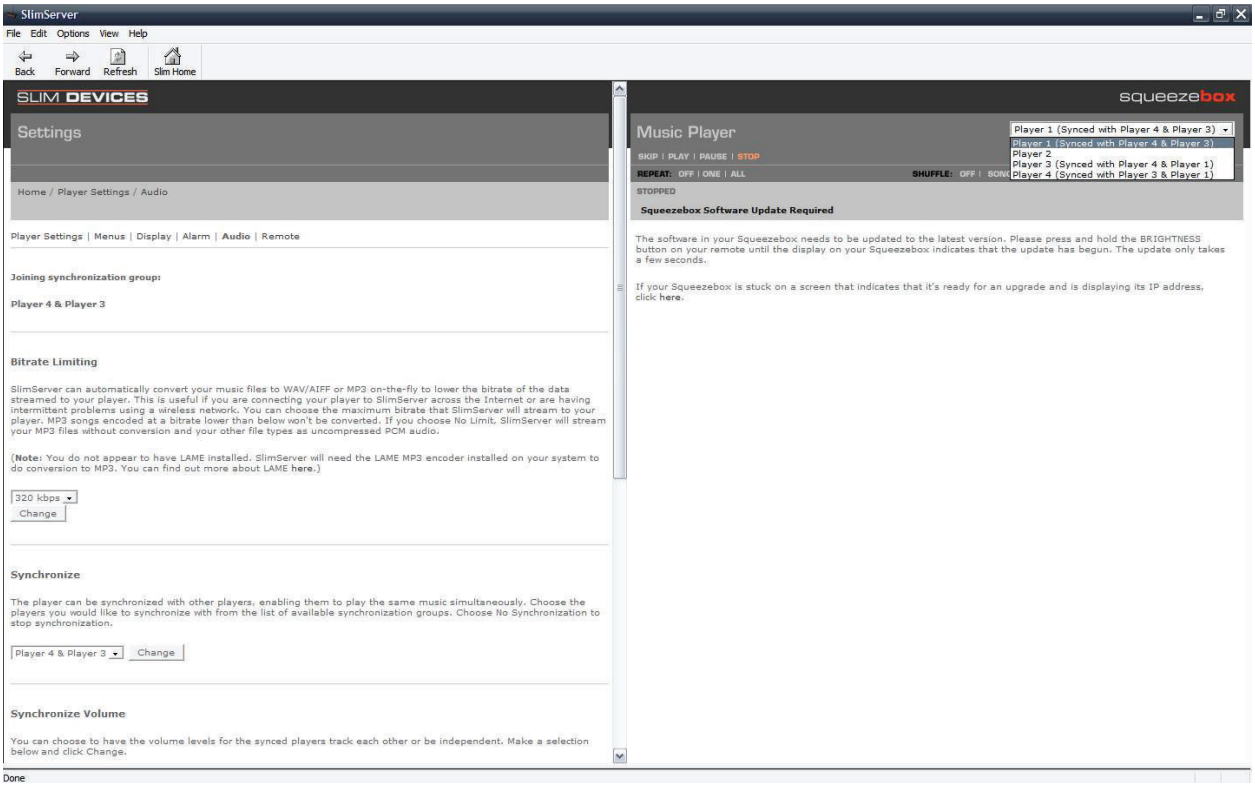



[4] At times I refer to Squeezebox or Softsqueeze devices, but as explained above, these are generally interchangeable as they show the same functionality. Softsqueeze runs on a computer whereas Squeezebox is a physical device with the same features and functionality. I do not intend reference to one to indicate exclusion of the other.

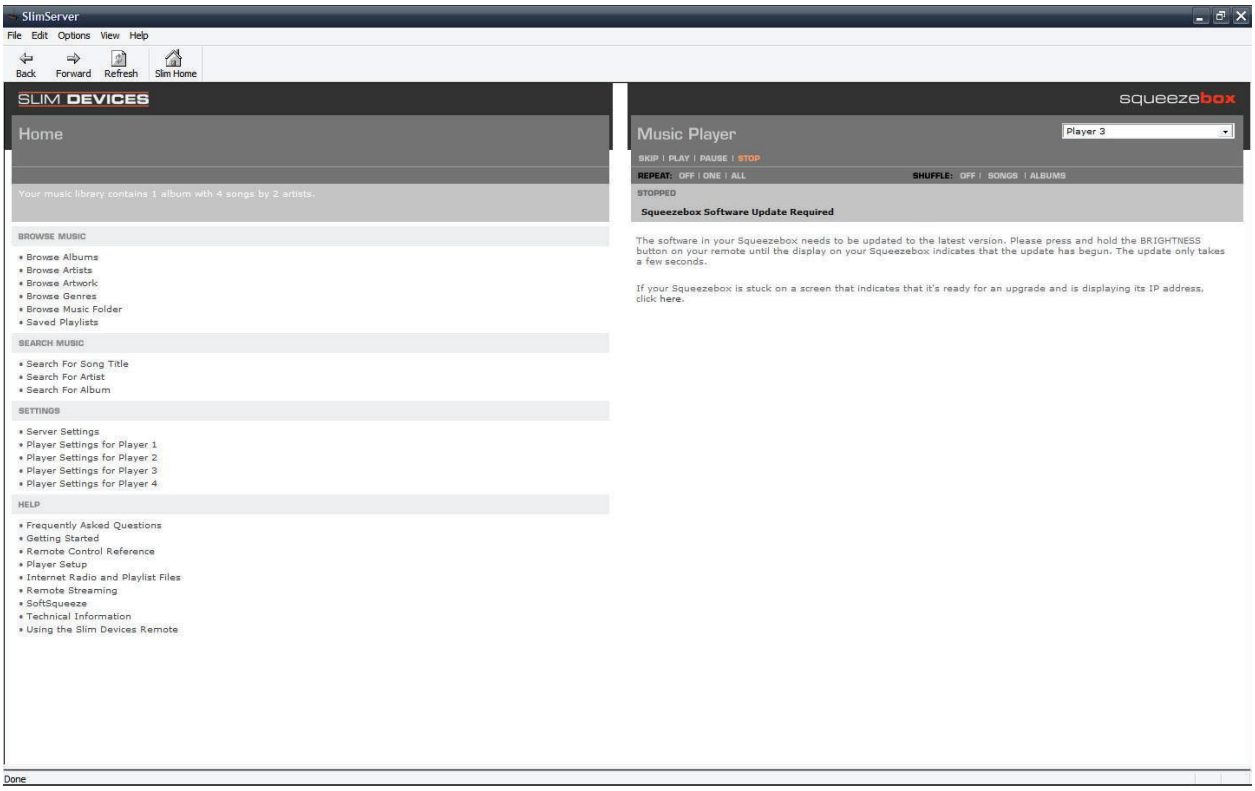



359. Slim Server allows a user to change the synchronization groups after they have been created and stored.

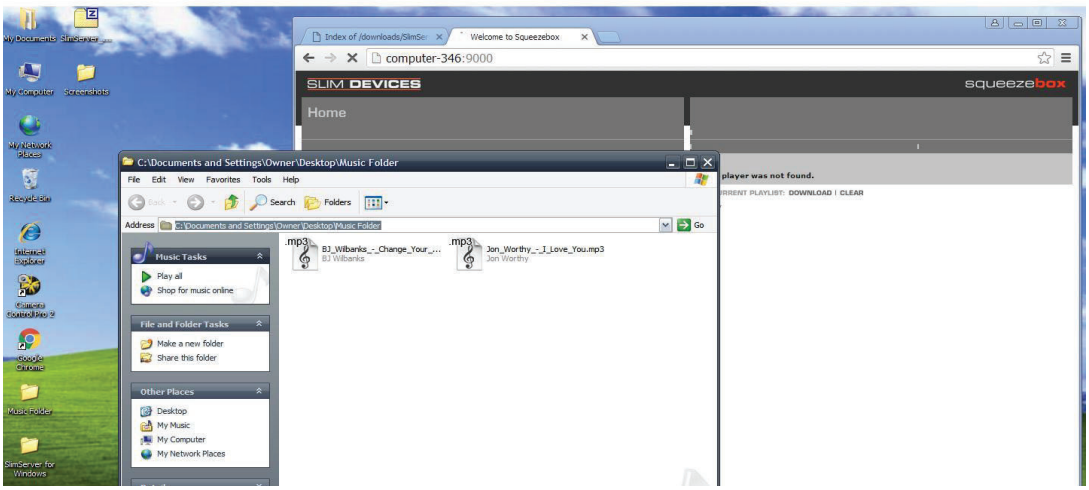


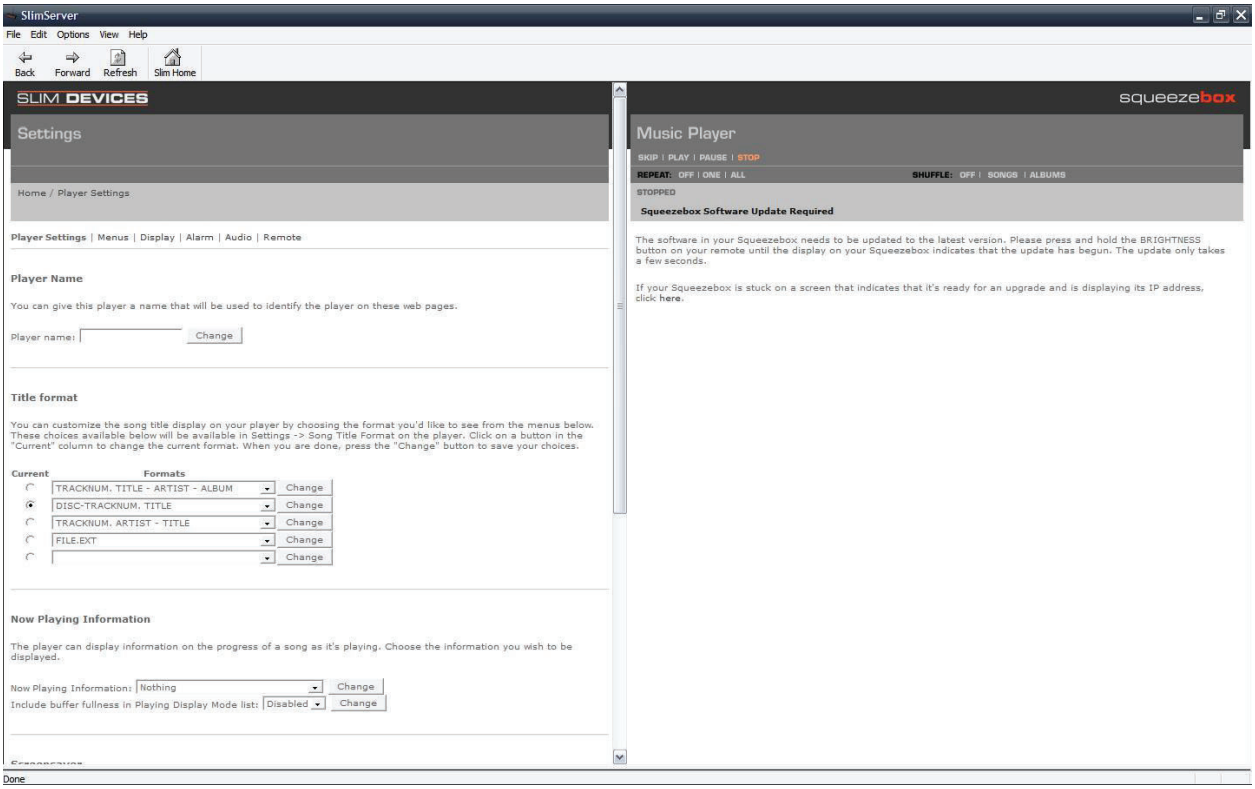

360. Slim Server also allows a Squeezebox to play media without being in a synchronization group, which corresponds to the claimed standalone mode.

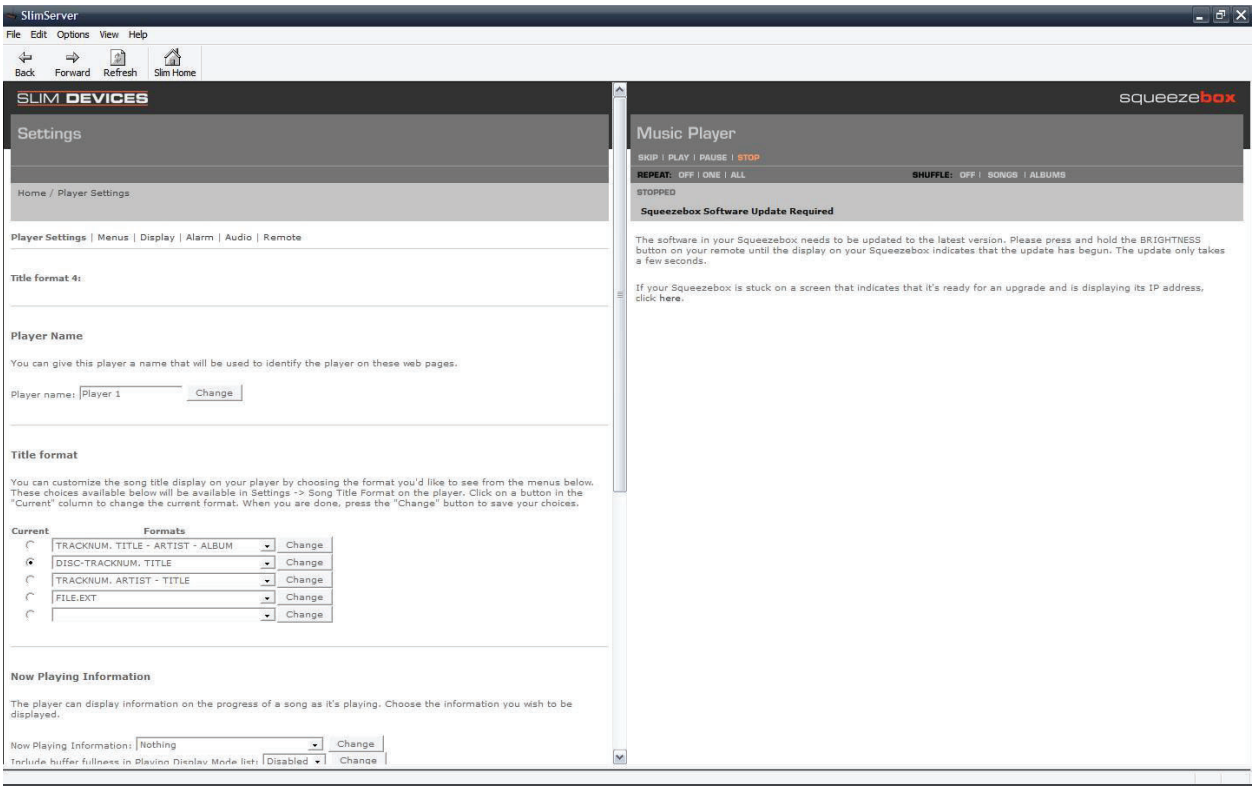


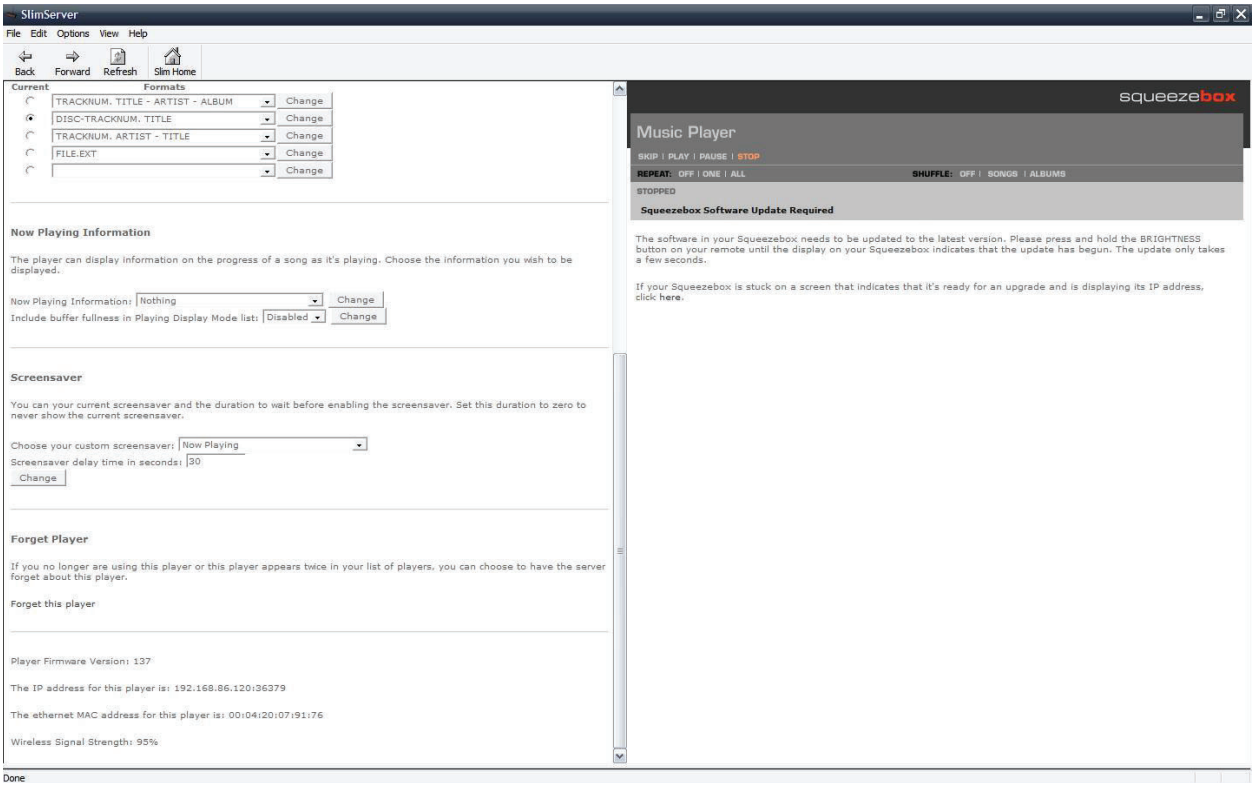

361. That media may be accessible to the SlimServer and organized and processed by the SlimServer software such that it can be delivered to one or more Squeezeboxes.



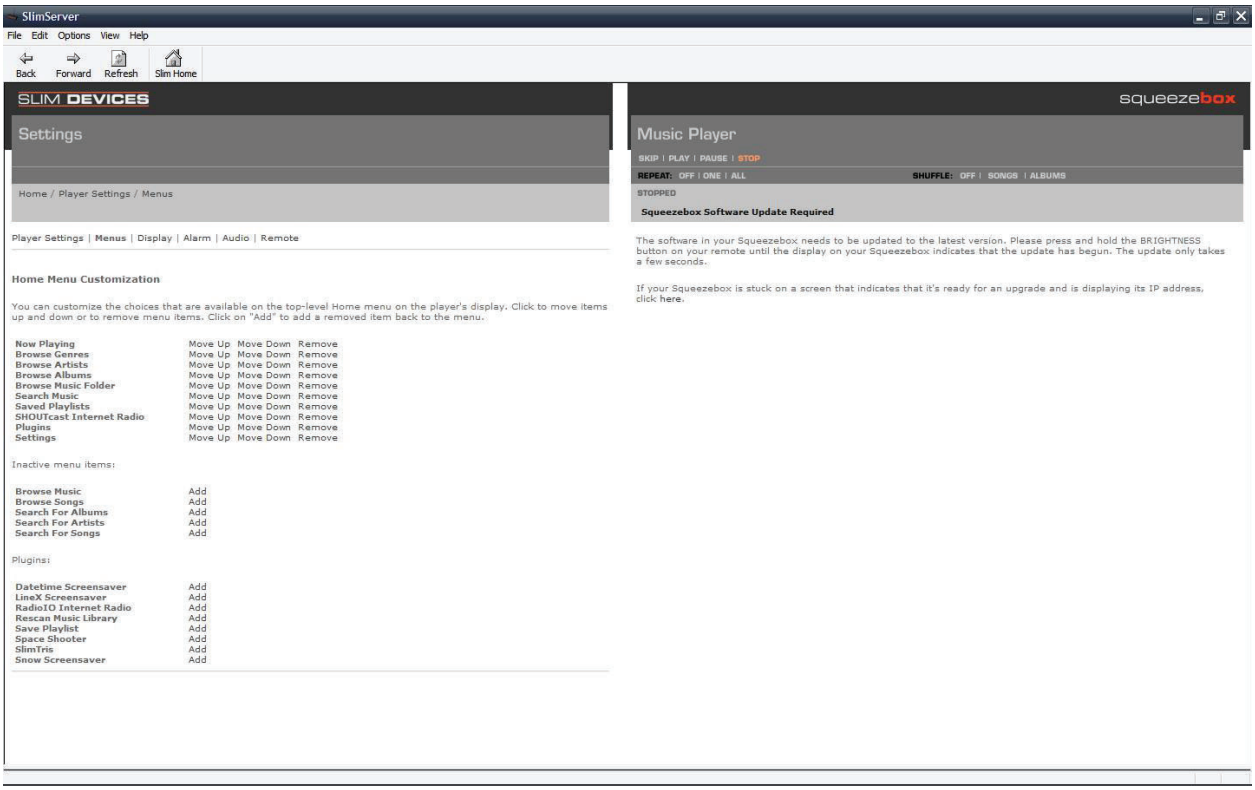
362. Slim Server also allows a user to change the format in which that media appears on the Squeezebox.

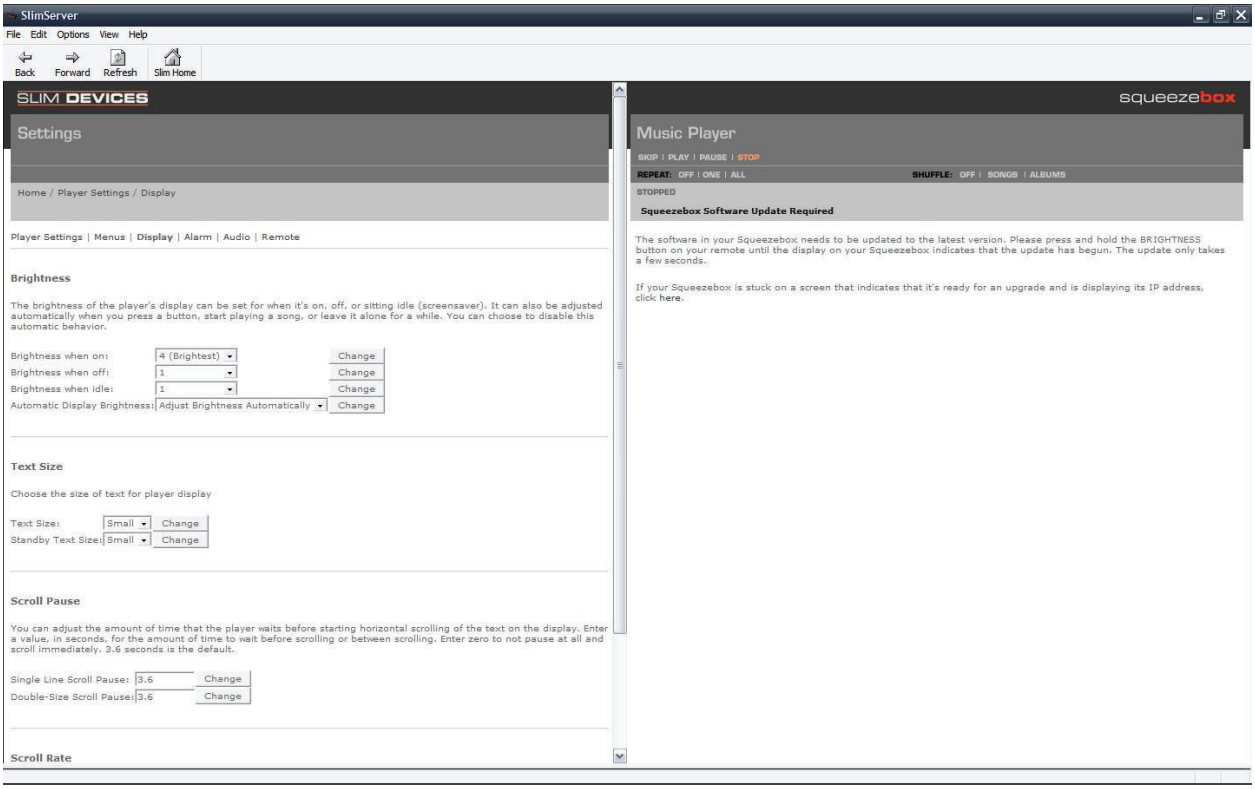


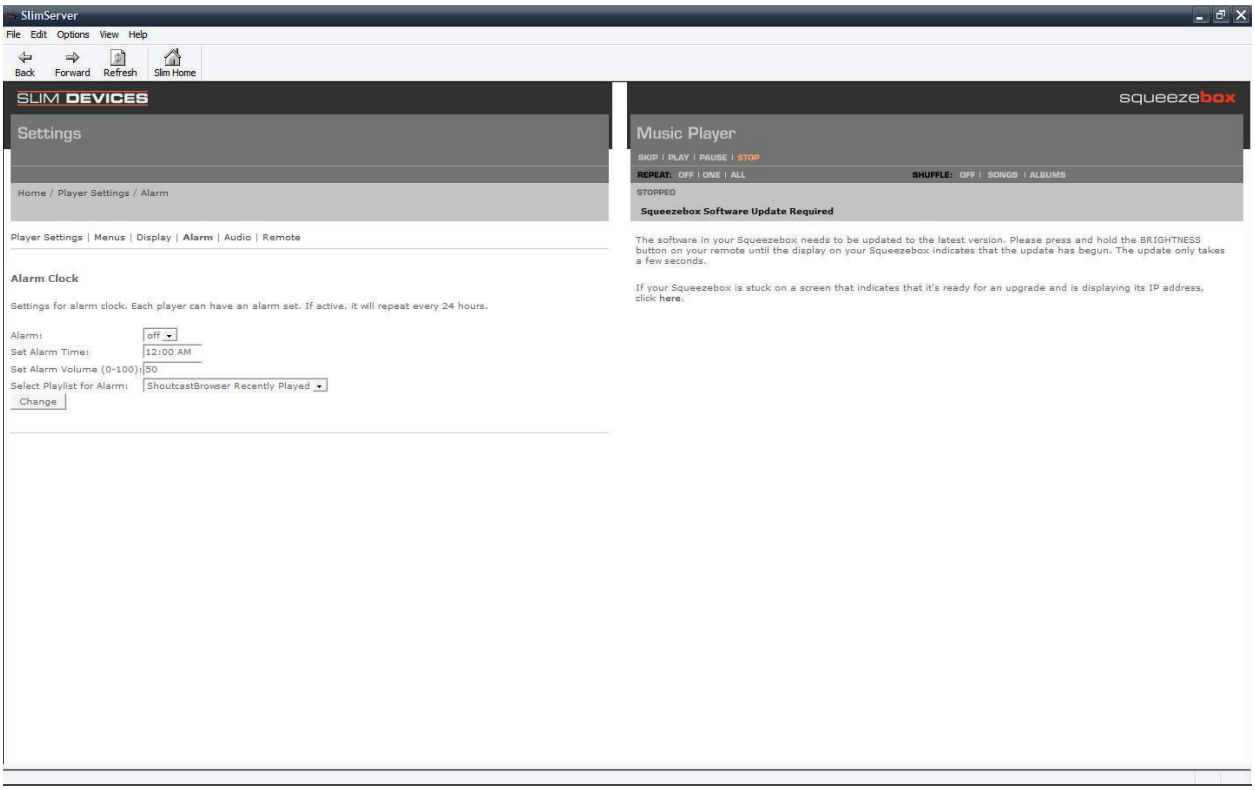


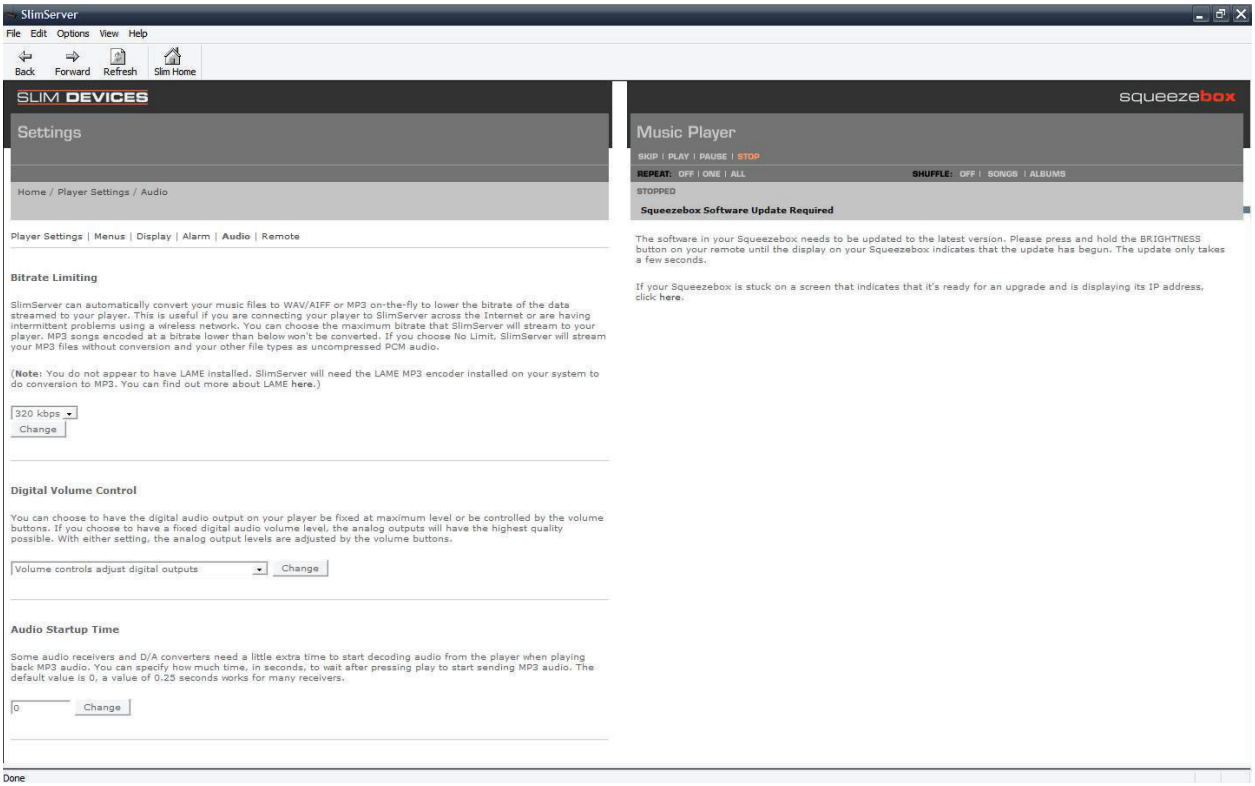



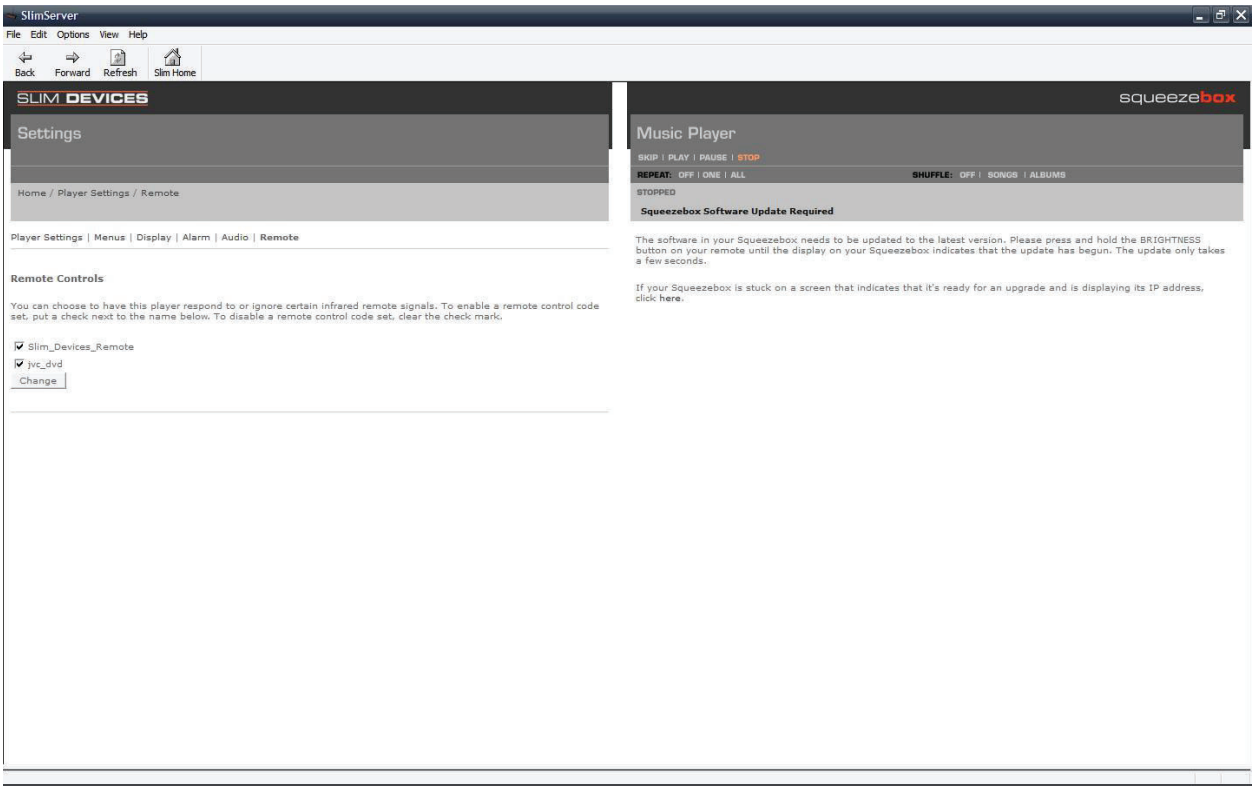

363. Menus and options on Squeezebox are customizable in the SlimServer software, and these configurations are stored in the Squeezebox devices.


SlimServer
File Edit Options View Help
Back Forward Refresh Slim Home
SLIM DEVICES
Settings
Home / Player Settings / Menus
Player Settings | Menus | Display | Alarm | Audio | Remote
Home Menu Customization
You can customize the choices that are available on the top-level Home menu on the player's display. Click to move items up and down or to remove menu items. Click on "Add" to add a removed item back to the menu.
Now Playing Move Up Move Down Remove
Browse Genres Move Up Move Down Remove
Browse Artists Move Up Move Down Remove
Browse Albums Move Up Move Down Remove
Browse Music Folder Move Up Move Down Remove
Search Music Move Up Move Down Remove
Saved Playlists Move Up Move Down Remove
SHOUTcast Internet Radio Move Up Move Down Remove
Plugins Move Up Move Down Remove
Settings Move Up Move Down Remove
Inactive menu items:
Browse Music Add
Browse Songs Add
Search For Albums Add
Search For Artists Add
Search For Songs Add
Plugins:
Datetime Screensaver Add
LineX Screensaver Add
RadioIO Internet Radio Add
Rescan Music Library Add
Save Playlist Add
Space Shooter Add
SlimTris Add
Snow Screensaver Add
squeezebox
Music Player
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
The software in your Squeezebox needs to be updated to the latest version. Please press and hold the BRIGHTNESS button on your remote until the display on your Squeezebox indicates that the update has begun. The update only takes a few seconds.
If your Squeezebox is stuck on a screen that indicates that it's ready for an upgrade and is displaying its IP address, click here.

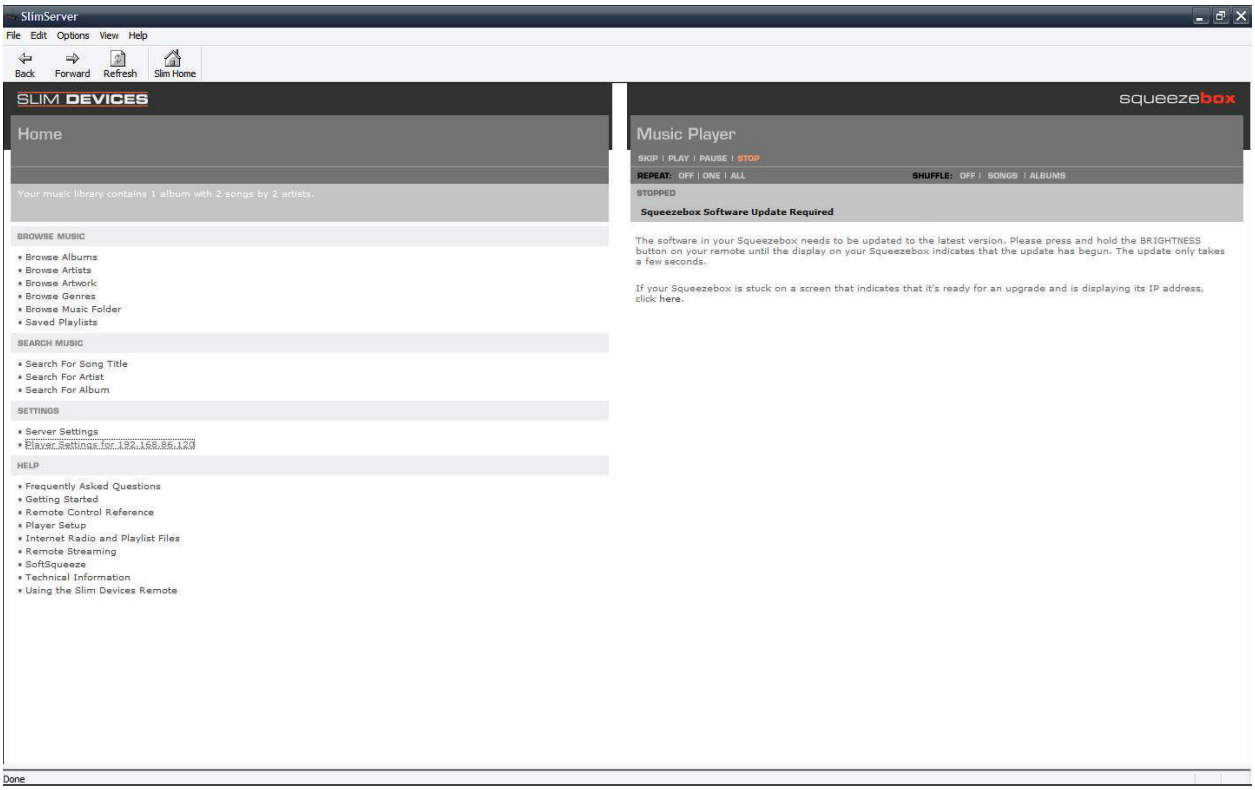

SlimServer
File Edit Options View Help
Back Forward Refresh Slim Home
SLIM DEVICES
Settings
Home / Player Settings / Display
Player Settings | Menus | Display | Alarm | Audio | Remote
Brightness
The brightness of the player's display can be set for when it's on, off, or sitting idle (screensaver). It can also be adjusted automatically when you press a button, start playing a song, or leave it alone for a while. You can choose to disable this automatic behavior.
Brightness when on: 4 (Brightest) Change
Brightness when off: 1 Change
Brightness when idle: 1 Change
Automatic Display Brightness: Adjust Brightness Automatically Change
Text Size
Choose the size of text for player display
Text Size: Small Change
Standby Text Size: Small Change
Scroll Pause
You can adjust the amount of time that the player waits before starting horizontal scrolling of the text on the display. Enter a value, in seconds, for the amount of time to wait before scrolling or between scrolling. Enter zero to not pause at all and scroll immediately. 3.6 seconds is the default.
Single Line Scroll Pause: 3.6 Change
Double-Size Scroll Pause: 3.6 Change
Scroll Rate
squeezebox
Music Player
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
The software in your Squeezebox needs to be updated to the latest version. Please press and hold the BRIGHTNESS button on your remote until the display on your Squeezebox indicates that the update has begun. The update only takes a few seconds.
If your Squeezebox is stuck on a screen that indicates that it's ready for an upgrade and is displaying its IP address, click here.

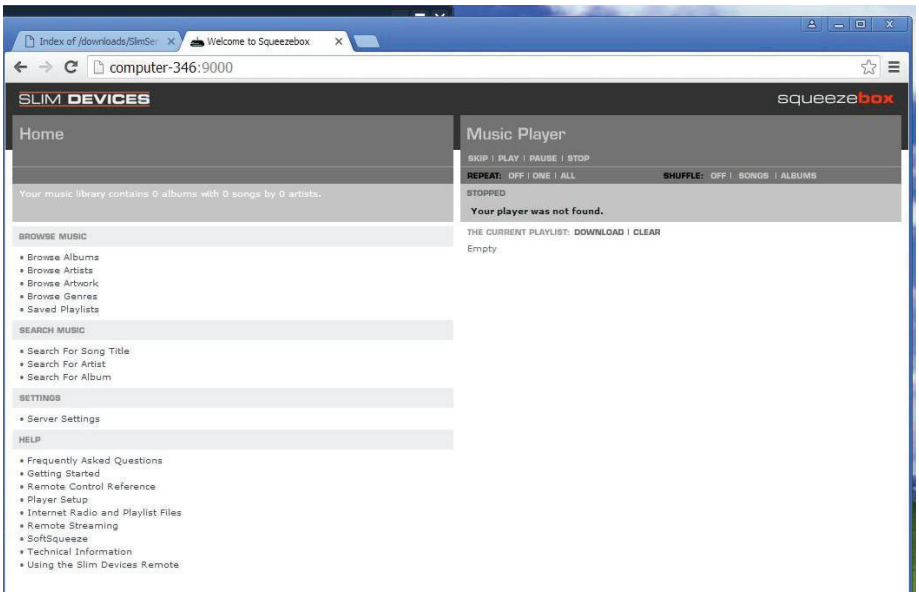

SlimServer
File Edit Options View Help
Back Forward Refresh Slim Home
SLIM DEVICES
Settings
Home / Player Settings / Alarm
Player Settings | Menus | Display | Alarm | Audio | Remote
Alarm Clock
Settings for alarm clock. Each player can have an alarm set. If active, it will repeat every 24 hours.
Alarm: off
Set Alarm Time: 12:00 AM
Set Alarm Volume (0-100): 50
Select Playlist for Alarm: ShoutcastBrowser Recently Played
Change
squeezebox
Music Player
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
The software in your Squeezebox needs to be updated to the latest version. Please press and hold the BRIGHTNESS button on your remote until the display on your Squeezebox indicates that the update has begun. The update only takes a few seconds.
If your Squeezebox is stuck on a screen that indicates that it's ready for an upgrade and is displaying its IP address, click here.

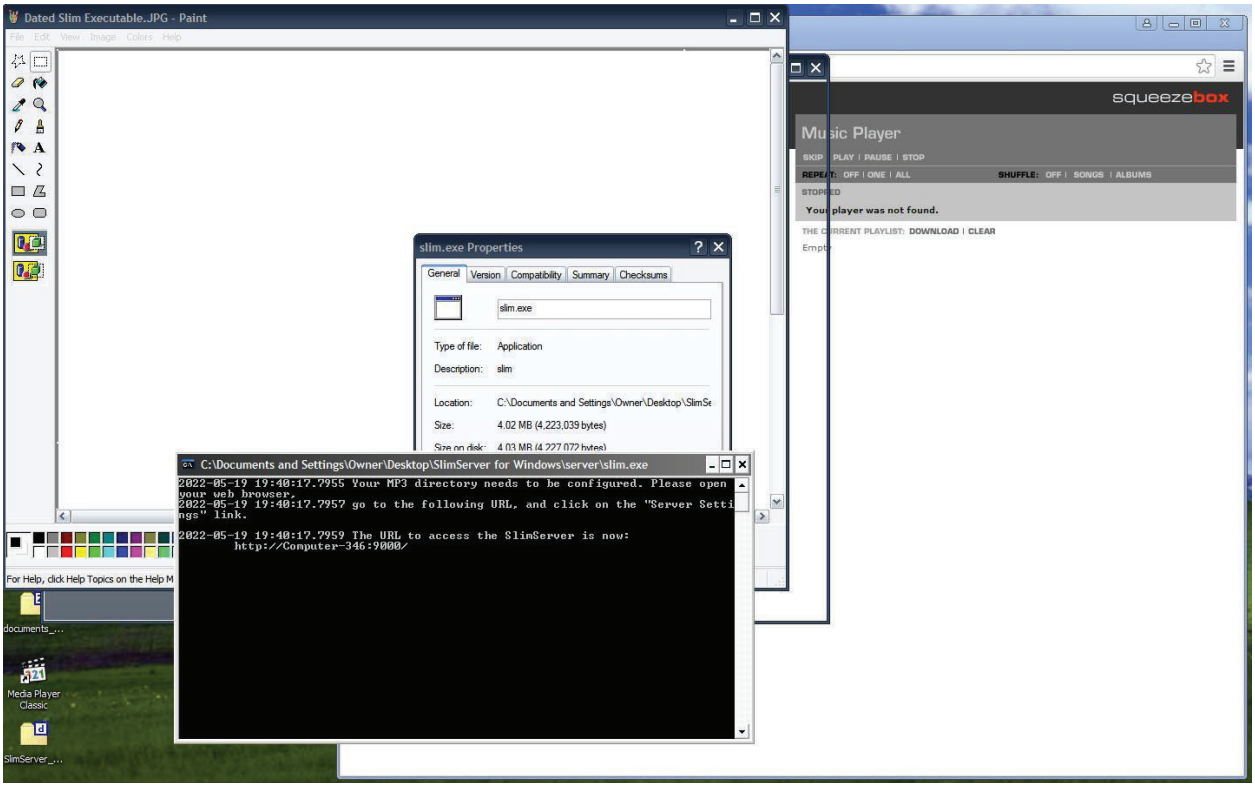

SlimServer
File Edit Options View Help
Back Forward Refresh Slim Home
SLIM DEVICES
Settings
Home / Player Settings / Audio
Player Settings | Menus | Display | Alarm | Audio | Remote
Bitrate Limiting
SlimServer can automatically convert your music files to WAV/AIFF or MP3 on-the-fly to lower the bitrate of the data streamed to your player. This is useful if you are connecting your player to SlimServer across the Internet or are having intermittent problems using a wireless network. You can choose the maximum bitrate that SlimServer will stream to your player. MP3 songs encoded at a bitrate lower than below won't be converted. If you choose No Limit, SlimServer will stream your MP3 files without conversion and your other file types as uncompressed PCM audio.
(Note: You do not appear to have LAME installed. SlimServer will need the LAME MP3 encoder installed on your system to do conversion to MP3. You can find out more about LAME here.)
320 kbps
Change
Digital Volume Control
You can choose to have the digital audio output on your player be fixed at maximum level or be controlled by the volume buttons. If you choose to have a fixed digital audio volume level, the analog outputs will have the highest quality possible. With either setting, the analog output levels are adjusted by the volume buttons.
Volume controls adjust digital outputs
Change
Audio Startup Time
Some audio receivers and D/A converters need a little extra time to start decoding audio from the player when playing back MP3 audio. You can specify how much time, in seconds, to wait after pressing play to start sending MP3 audio. The default value is 0, a value of 0.25 seconds works for many receivers.
0
Change
squeezebox
Music Player
SKIP | PLAY | PAUSE | STOP
REPEAT: OFF | ONE | ALL
SHUFFLE: OFF | SONGS | ALBUMS
STOPPED
Squeezebox Software Update Required
The software in your Squeezebox needs to be updated to the latest version. Please press and hold the BRIGHTNESS button on your remote until the display on your Squeezebox indicates that the update has begun. The update only takes a few seconds.
If your Squeezebox is stuck on a screen that indicates that it's ready for an upgrade and is displaying its IP address, click here.
Done

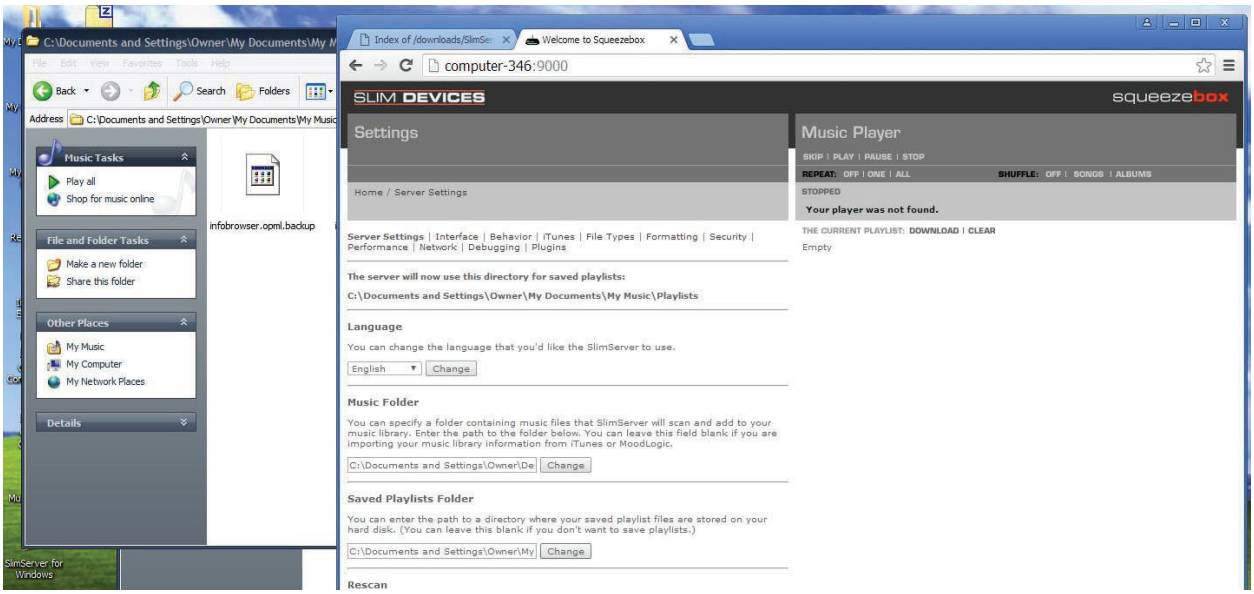


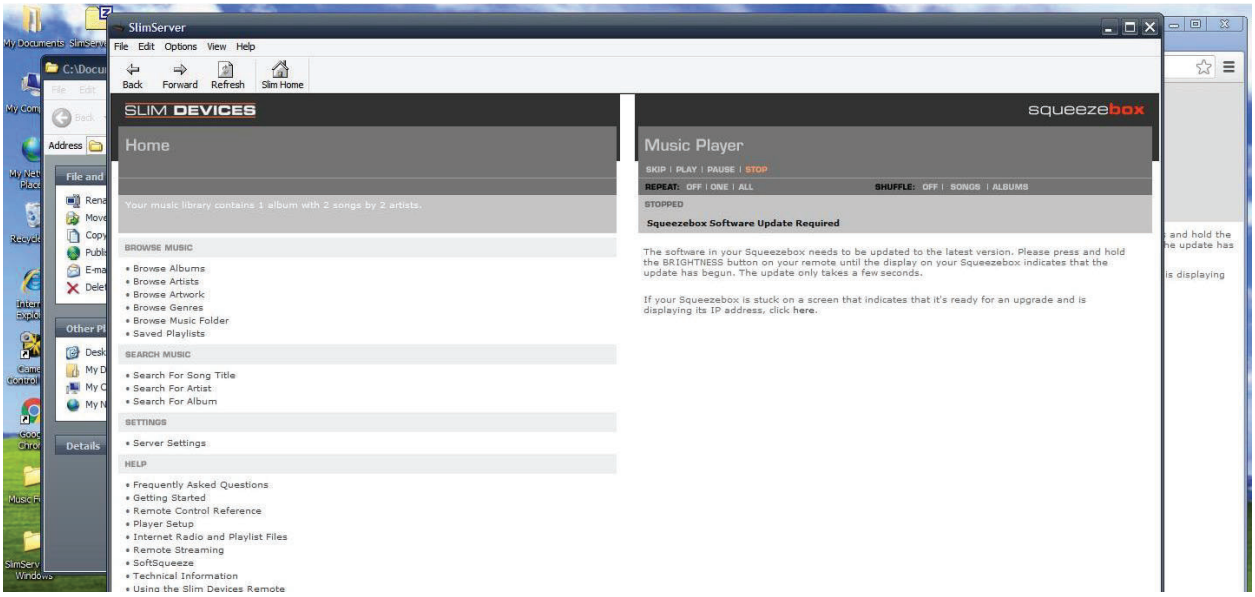

364. The user may name the Squeezebox something other than its IP address.




Welcome to Squeezebox
computer-346:9000
SLIM DEVICES
squeezebox
Home
Music Player
Your music library contains 0 albums with 0 songs by 0 artists.
Your player was not found.
BROWSE MUSIC
• Browse Albums
• Browse Artists
• Browse Artwork
• Browse Genres
• Saved Playlists
SEARCH MUSIC
• Search For Song Title
• Search For Artist
• Search For Album
SETTINGS
• Server Settings
HELP
• Frequently Asked Questions
• Getting Started
• Remote Control Reference
• Player Setup
• Internet Radio and Playlist Files
• Remote Streaming
• SoftSqueeze
• Technical Information
• Using the Slim Devices Remote


Dated Slim Executable.JPG - Paint
slim.exe Properties
General
Version
Compatibility
Summary
Checksums
slim.exe
Type of file: Application
Description: slim
Location: C:\Documents and Settings\Owner\Desktop\SlimSe
Size: 4.02 MB (4,223,039 bytes)
C:\Documents and Settings\Owner\Desktop\SlimServer for Windows\server\slim.exe
2022-05-19 19:40:17.7955 Your MP3 directory needs to be configured. Please open your web browser,
2022-05-19 19:40:17.7957 go to the following URL, and click on the "Server Settings" link.
2022-05-19 19:40:17.7959 The URL to access the SlimServer is now:
http://Computer-346:9000/
squeezebox
Music Player
Your player was not found.
For Help, click Help Topics on the Help M
Media Player Classic




365. As discussed above, SlimServer supports synchronizing multiple Squeezebox players so that they play the same audio.

> **How do I synchronize two Squeezeboxes so they play the same audio?**
>
> Navigate into the Player Settings area with the remote control. Choose Synchronize, then select the other player you want to synchronize with and press the RIGHT button. Both will play the same thing and you can control their synchronized playback from either remote. Go back to the same place and press RIGHT again to unsync.
>
> You can also set up synchronziation from the Player Settings page in the web interface.

**Error! Hyperlink reference not valid.** → Home / Frequently Asked Questions → HTML/EN/faqquestions.html.

366. The source code confirms that Squeezebox discloses this claim limitation. The SlimServer server represents sync groups internally using the 'master', 'slaves', and 'syncgroupid' properties for a client (player). The properties are maintained as indexed array elements and accessed using accessor methods — master(), slaves(), and syncgroupid(). A sync group has one group member designated as master, with the remaining group members designated as slaves. For a master client, the 'slaves' property represents an array of slaves which are synced to it. A player is a master if its list of slaves is not empty. For a slave player, the 'master' property points to the master client. A player is a slave if its master property is defined. All members of a group share the same syncgroupid. A client is considered to be synced if it either has slaves or has a master. An unsynced client does not have either a master or slaves.

**Slim/Player/Client.pm (v5.3.1)**

```
=item

master() - type: client

        if we're synchronized, 'master' points to master client

=item

slaves() - type: clients

        if we're a master, this is an array of slaves which are synced to us

=item

syncgroupid() - type: uniqueid

        unique identifier for this sync group
```

Slim::Player::Client::master() comment, Slim/Player/Client.pm (v5.3.1), 297–301
Slim::Player::Client::slaves() comment, Slim/Player/Client.pm (v5.3.1), 303–307
Slim::Player::Client::syncgroupid() comment, Slim/Player/Client.pm (v5.3.1), 309–313
Slim::Player::Client::master(), Slim/Player/Client.pm (v5.3.1), 1195–1198
Slim::Player::Client::slaves(), Slim/Player/Client.pm (v5.3.1), 1199–1204
Slim::Player::Client::syncgroupid(), Slim/Player/Client.pm (v5.3.1), 1205–1208
Slim::Player::Sync::isMaster(), Slim/Player/Sync.pm (v5.3.1), 351–358
Slim::Player::Sync::master(), Slim/Player/Sync.pm (v5.3.1), 360–366

Slim::Player::Sync::slaves(), Slim/Player/Sync.pm (v5.3.1), 368–373
Slim::Player::Sync::isSlave(), Slim/Player/Sync.pm (v5.3.1), 376–381
Slim::Player::Sync::isSynced(), Slim/Player/Sync.pm (v5.3.1), 388–391

367. When a player (slave) is synced with a master, that player shares the master's playlist.

**Slim/Player/Client.pm (v5.3.1)**

```
=item

playlist() - type: array

        playlist of songs  (when synced, use the master's)
```

**Slim/Player/Playlist.pm**

```
sub playList {
        my ($client) = shift;

        $client = Slim::Player::Sync::masterOrSelf($client);

        return $client->playlist;
}
```

Slim::Player::Client::playlist() comment, Slim/Player/Client.pm (v5.3.1), 207–211
Slim::Player::Client::playlist(), Slim/Player/Client.pm (v5.3.1), 1136–1141
Slim::Player::Playlist::playlist(), Slim/Player/Playlist.pm (v5.3.1), 54–60

368. The SlimServer persists the membership of a sync group by storing the definition of the syncgroupid property for each group member into the SlimServer's preferences file. When a first player is synced with a second player, the first player is assigned the same syncgroupid as the second player's master. If the master does not already have a syncgroupid, a new one is generated first.

**Slim/Player/Sync.pm (v5.3.1)**

```
sub saveSyncPrefs {

        my $client = shift;
        my $temp = shift;
        my $clientID = $client->id();
        if (isSynced($client)) {

                if (!defined($client->master->syncgroupid)) {
                        $client->master->syncgroupid(int(rand 999999999));
                }

                my $masterID = $client->master->syncgroupid;
                # Save Status to Prefs file
                $::d_sync && msg("Saving $clientID as a slave to $masterID\n");
                Slim::Utils::Prefs::clientSet($client,'syncgroupid',$masterID);
                Slim::Utils::Prefs::clientSet($client->master,'syncgroupid',$masterID);

        }
        if ($temp) {
                $::d_sync && msg("Idling Sync for $clientID\n");
        } else {
                $client->syncgroupid(undef);
                Slim::Utils::Prefs::clientDelete($client,'syncgroupid');
                $::d_sync && msg("Clearing Sync master for $clientID\n");
        }
}
```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 169–194

369. A SlimServer can be instructed to synchronize a first player with a second player in a number of ways, such as by using the web interface, using the CLI, or by using the directional ("arrow") buttons on the remote to change the synchronization settings. The following discussion focuses on using the remote buttons. The screenshots are for the SoftSqueeze player. The player sends an IR remote code using the SlimProto 'IR' command to SlimServer for processing.

**"IR "** (Note the two spaces to make it up to 4 characters.)

One of these packets is recieved for each IR code recieved by the player.

**Data Length:** Fixed at 10 bytes.

**Format:**

| | | |
|---|---|---|
| Time | 4 bytes | Time since player startup in ticks (@1Khz) |
| Format | 1 byte | Code Format (ignored by the server for now - Code represents type of IR code - NEC, JVC or Sony) |
| NoBits | 1 byte | Length of IR Code (ignored by the server for now - 16 bits for JVC, 32 bits for NEC?) |
| IRCode | 4 bytes | the IR Code itself (upto 32 bits) |

http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html
HTML/EN/html/docs/slimproto.html

370. SlimServer receives IR remote codes and enqueues them for processing.

Slim::Networking::Slimproto::process_slimproto_frame(),
Slim/Networking/Slimproto.pm, at 247–486 at 357–371

371. The enqueued IR remote codes are processed as a 'button' command. Button actions are looked up in the function map for the current mode.

Slim::Hardware::IR::idle(), Slim/Hardware/IR.pm, 39–43 at 41
Slim::Control::Command::execute(), Slim/Control/Command.pm, 24–713 at 686
Slim::Hardware::IR::processIR(), Slim/Hardware/IR.pm, 334–393 at 388
Slim::Hardware::IR::processCode(), Slim/Hardware/IR.pm, 552–571 at 569
Slim::Control::Command::execute(), Slim/Control/Command.pm, 24–713 at 683
Slim::Hardware::IR::executeButton(), Slim/Hardware/IR.pm, 510–550

372. In particular, the IR buttons allow navigation through the Settings to a 'Synchronize' menu to allow an unsynced player to be synchronized with a synchronization group. For example, the directional keys can be used to navigate to the 'Synchronize' menu.

373. The up and down buttons allow selection of synchronization groups. The right button causes the current player to sync with the selected synchronization group. In this example, pressing the right button causes the server to sync player1 with player2 and player3. In the Synchronize mode, the right button causes the client to be synchronized with the selected synchronization group if not already synchronized.

**Slim/Buttons/Synchronize.pm (v5.3.1)**

```
        'right' => sub  {
                my $client = shift;

                my $selectedClient = $client->syncSelections($client->syncSelection);

                my @oldlines = Slim::Display::Display::curLines($client);

                if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || ($client eq $selectedClient))
{
                        Slim::Player::Sync::unsync($client);
                } else {
                        Slim::Player::Sync::sync($client, $selectedClient);
                }
                $client->pushLeft(\@oldlines, [Slim::Display::Display::curLines($client)]);
        },
```

$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm, 34–47 at 44
Slim::Player::Sync::sync(), Slim/Player/Sync.pm, 132–167

374. After the synchronization, SlimServer stores the updated syncgroupid settings to the preferences file.

**Slim/Player/Sync.pm (v5.3.1)**

```
sub saveSyncPrefs {

        my $client = shift;
        my $temp = shift;
        my $clientID = $client->id();
        if (isSynced($client)) {

                if (!defined($client->master->syncgroupid)) {
                        $client->master->syncgroupid(int(rand 999999999));
                }

                my $masterID = $client->master->syncgroupid;
                # Save Status to Prefs file
                $::d_sync && msg("Saving $clientID as a slave to $masterID\n");
                Slim::Utils::Prefs::clientSet($client,'syncgroupid',$masterID);
                Slim::Utils::Prefs::clientSet($client->master,'syncgroupid',$masterID);

        }
        if ($temp) {
                $::d_sync && msg("Idling Sync for $clientID\n");
        } else {
                $client->syncgroupid(undef);
                Slim::Utils::Prefs::clientDelete($client,'syncgroupid');
                $::d_sync && msg("Clearing Sync master for $clientID\n");
        }
}
```

Slim::Player::Sync::sync(), Slim/Player/Sync.pm, 132–167 at 163
Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm, 169–194 at 174–184

375. In this example, the preferences file identifies player1, player2, and player3 with

the same syncgroupid (450486363).

**slimserver.conf**

```
0f:59:51:64:dc:d7-playername = player2
...
0f:59:51:64:dc:d7-syncgroupid = 450486363
...
51:93:a5:ad:53:20-playername = player3
...
51:93:a5:ad:53:20-syncgroupid = 450486363
...
bc:39:f3:c4:1e:29-playername = player1
...
bc:39:f3:c4:1e:29-syncgroupid = 450486363
```

376. After performing the synchronization action and saving preferences, the server sends updated screen lines to the server indicating that the right-button action has been changed to unsync with player2 and player3. The updated message encoded into an update that pushes the old pre-sync message lines (@oldlines) off the screen to the left, replaced with new screen lines.

**Slim/Buttons/Synchronize.pm (v5.3.1)**

```
        'right' => sub  {
                my $client = shift;

                my $selectedClient = $client->syncSelections($client->syncSelection);

                my @oldlines = Slim::Display::Display::curLines($client);

                if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || ($client eq $selectedClient))
{
                        Slim::Player::Sync::unsync($client);
                } else {
                        Slim::Player::Sync::sync($client, $selectedClient);
                }
                $client->pushLeft(\@oldlines, [Slim::Display::Display::curLines($client)]);
        },
```

377. Because the player is now synced, the updated screen lines change from the localized SYNC_WITH message to the localized UNSYNC_WITH message.

**Slim/Buttons/Synchronize.pm (v5.3.1)**

```
sub lines {
        my $client=shift;
        my $line1;
        my $line2;
        my $symbol = undef;

        loadList($client);

        if (scalar @{$client->syncSelections} < 1) {
                warn "Can't sync without somebody to sync with!";
                Slim::Buttons::Common::popMode($client);
        } else {
                        # get the currently selected client
                        my $selectedClient = $client->syncSelections($client->syncSelection);

                        if (Slim::Player::Sync::isSyncedWith($client, $selectedClient) || $selectedClient eq
$client) {
                                $line1 = Slim::Utils::Strings::string('UNSYNC_WITH');
                        } else {
                                $line1 = Slim::Utils::Strings::string('SYNC_WITH');
                        }
                        $line2 = buddies($client, $selectedClient);
        }
        return ($line1, $line2, undef, Slim::Display::Display::symbol('rightarrow'));
}
```

$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm, 34–47 at 46
Slim::Display::Display::curLines(), Slim/Display/Display.pm, 104–120 at 115
Slim::Buttons::Synchronize::lines(), Slim/Buttons/Synchronize.pm, 67–90 at 79–87
UNSYNC_WITH localization, strings.txt, 6531–6540

378. The old and new screen lines are rendered into start and end graphic (bit), which are concatenated into one large screen. SlimServer then issues a series of Slimproto frame buffer messages (‘grfd’ messages for SqueezeboxG devices) to the player over TCP, starting with a screen that shows only the start screen lines and then shifting left in successive messages until the final message shows only the end screen lines.

$Slim::Buttons::Synchronize::functions{'right'}, Slim/Buttons/Synchronize.pm, 34–47 at 46
Slim::Player::SqueezeboxG::pushLeft(), Slim/Player/SqueezeboxG.pm, 401–414 at 413
Slim::Player::SqueezeboxG::pushUpdate(), Slim/Player/SqueezeboxG.pm, 447–464 at 459
Slim::Player::SqueezeboxG::drawFrameBuf(), Slim/Player/SqueezeboxG.pm, 368–382 at 380
Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm, 514–533

379. The 'grfd' message is not documented in "The SlimProto TCP Protocol" page that is included with the v5.3.1 distribution, but it is mentioned in the "SlimProtoTCP protocol" page on the Squeezebox wiki as being used to draw graphics for SqueezeboxG. *E.g.*, https://wiki.slimdevices.com/index.php/SlimProtoTCPProtocol.html#Command_.22grfd.22.

380. As discussed above, for example, a network device may comprise a SlimServer connected to Squeezeboxes or Softsqueezes over a data network (Ethernet or Wi-Fi) and it may provide an indication to the Squeezebox or Softsqueeze players that it has been added to a synchronization group comprising one or more other Squeezebox or Softsqueeze players, including a graphical indication displayed on those players. When media is played to the synchronization group, the players—depending on their configuration as discussed further below—within that group will respond and play back music synchronously.

1) Obviousness – Sonos Forums

381. It would also have been obvious to modify the Squeezebox to add this claim limitation, to the extent it is not disclosed. For example, the Sonos Forums described *supra* (and fully incorporated herein by reference), disclose the "macro" / "zone scene" Sonos allegedly invented. Below are two individual posts describing the "zone scenes" under Sonos's construction, but the voluminous posts from the Sonos Forums excerpted above further describe this functionality.

**Macro / presets**

16 years ago · 61 replies

JeffT

Just got the intro bundle, and I am impressed. I did a search and did not find this suggested, but I would save Zone links as favorites. With only 2 ZPs it is not a problem yet, but when I add more it maybe. I would like to setup say Morning mode for the units I want in the morning and a preset volume between the units. Another example I would have 2 party modes, Summer and Winter. The Summer mode would include the deck speakers and the Winter mode would not. Also it would be nice to have playlists or radio station associated with each mode. So when I get up I press Morning the DI Chill radio station plays.

Jeff

Farrar Dep. Ex. 6 at 1.

**Virtual Zones and Zone Grouping**

17 years ago · 190 replies

theboyg

This "link/unlink" business is really cumbersome - and not a joy to use which goes against the ease of use of the rest of the system.

Why can't I have a virtual zone - ie a zone called "Downstairs" - and I can group all my downstairs zones into this. Then I dont have to keep manually linking/unlinking multiple zones everytime.

PLEASE !

G.

2 people like this

Exhibit 0008

Farrar Dep. Ex. 8 at 1.

382. As Mr. Lambourne testified, the users requesting "virtual zones" and "macro" or

"preset" groups disclosed the "zone scene" concept. Lambourne Dep. Tr. at 131 ("Q. Did your invention address the concerns of these users through adding Zone Scenes? THE WITNESS: Yes. My invention would describe the need described here. Q. Why is that? A. By allowing a user to save zone groupings or linking, as being referred to here.") (objections omitted). The named and saved groups also meet Sonos's requirements that for a group to be a "zone scene" that it must be named and saved and play back music synchronously because the zone linking/macro functionality described in the Sonos forums was describing the synchronous playback already found in the Sonos System (and as described in the invalidity ground below). The "virtual zones" and "macros" save the groups, as shown in those forum posts, and the users are attributing names to them like "Downstairs."

*(viii) Limitation 1.7: "(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player;"*

383. In my opinion, Squeezebox discloses or renders obvious this claim limitation.

384. I incorporate by reference my discussion of limitation 1.6 herein, which discloses receiving from a network device an indication that the zone player has been added to a zone scene comprising a predefined grouping of zone players that are to be configured for synchronous playback of media when the zone scene is invoked. Limitation 1.7 adds the limitation that the first zone player is a member of two different "zone scenes."

385. The SlimServer configuration, including the definitions of the sync groups, is

stored into a preferences file. However, a single player may be defined in separate sync groups on different SlimServer configurations, persisted to different preferences files. As one example, a player may be used with different servers, which define different sync groups and persist to different preferences files. One example (v6.2.1) is using a player both with a local SlimServer and with the SqueezeNetwork. As another example, a player may be used with different invocations of the same server. Each invocation uses a different preference file, specified on the command line using the '--prefsfile' option.

**How do I synchronize two Squeezeboxes so they play the same audio?**

Navigate into the Player Settings area with the remote control. Choose Synchronize, then select the other player you want to synchronize with and press the RIGHT button. Both will play the same thing and you can control their synchronized playback from either remote. Go back to the same place and press RIGHT again to unsync.

You can also set up synchronziation from the Player Settings page in the web interface.

**Error! Hyperlink reference not valid.** →
HTML/EN/faqquestions.html →
Home / Frequently Asked Questions

386. Depending on configuration, the Squeezebox/SlimServer system can separate sync group definition from active sync group participation with respect to powered-off players.

387. A Squeezebox player, including SoftSqueeze, can be commanded by SlimServer to power on or off. The "power off" status does not reflect the player being fully powered off (at least for SoftSqueeze). Instead, the player enters a dormant state and can be commanded to power back on.

388. For example, a player that is powered on but in the STOP state displays an active screen (e.g., Now Playing) at normal brightness:

389. When powered off, the player displays the date and time at a dimmed brightness.

390. In the Squeezebox/SlimServer system, a player may be configured to power on/off either independently of its sync group or together with all the other players in its sync group.

http://<slimserver_addr>:9000/setup.html?page=audio&player=<PLAYER>&playerid=<PLAYER_ID>

Home / Player Settings / Audio

SETUP_SYNC_POWER_DESC, strings.txt (v5.3.1), 1518–1523

391. A powered-off player is temporarily unsynced but still defined to be part of the persistent sync group. Because a player can be configured to turn on/off independently of its sync group, a persistently defined sync group may include players that are powered off and not actively participating in a sync group. A powered-off player is "temporarily" unsynced from its sync group. See, e.g. (v5.3.1): Error rendering macro 'code': Invalid value specified for parameter 'com.atlassian.confluence.ext.code.render. InvalidValueException:

```
                        ,'syncPower' => {
                                                        'validate' =>
\&validateTrueFalse
                                                        ,'options' => {
                                                                '1' => string
('SETUP_SYNCPOWER_ON')
                                                                ,'0' =>
string('SETUP_SYNCPOWER_OFF')
                                                        }
                                                        ,'onChange' => sub {
                                                                my
($client,$changeref,$paramref,$pageref) = @_;
                                                                return if (!defined
($client));
                                                                my $value =
$changeref->{'syncPower'}{'new'};
                                                                my @buddies = Slim::
Player::Sync::syncedWith($client);
                                                                if (scalar(@buddies)
> 0) {
                                                                        foreach my
$eachclient (@buddies) {
                                                                                if
(!$value && !$eachclient->power()) {
#temporarily unsync off players if on/off set to separate
Slim::Player::Sync::unsync($client,1);
                                                                                }
Slim::Utils::Prefs::clientSet($eachclient,'syncPower',$value);
                                                                        }
                                                                }
                                                        }
                                                }
```

Slim::Web::Setup::initSetupConfig(), Slim/Web/Setup.pm (v5.3.1), 103–2118 at 951–972

**Slim/Buttons/Power.pm (v5.3.1)**

```
sub setMode {
        my $client = shift;
        $client->lines(\&lines);
        my $sync = Slim::Utils::Prefs::clientGet($client,'syncPower');
        if (defined $sync && $sync == 0) {
                $::d_sync && Slim::Utils::Misc::msg("Temporary Unsync ".$client->id()."\n");
                Slim::Player::Sync::unsync($client,1);
        }

        if (Slim::Player::Source::playmode($client) eq 'play' && Slim::Player::Playlist::song($client)) {
                if (Slim::Music::Info::isRemoteURL(Slim::Player::Playlist::song($client))) {
                        Slim::Control::Command::execute($client, ["stop"]);
                } else {
                        Slim::Control::Command::execute($client, ["pause", 1]);
                }
        }

        # switch to power off mode
        # use our last saved brightness
        $client->brightness(Slim::Utils::Prefs::clientGet($client, "powerOffBrightness"));
        $client->update();
}
```

392. When a non-master player is temporarily unsynced from its group, it is removed from the master/slave data structures in dynamic memory. The player is removed from the master's list, and the player's 'master' property is set to undefined.

**Slim/Player/Sync.pm (v5.3.1)**

```
} elsif (isSlave($client)) {
        # if we're a slave, remove us from the master's list
        my $i = 0;
        foreach my $c (@{($client->master())->slaves}) {
                if ($c->id() eq $client->id()) {
                        splice @{$client->master->slaves}, $i, 1;
                        last;
                }
                $i++;
        }

        # and copy the playlist to the now freed slave
        my $master = $client->master;
        Slim::Player::Playlist::copyPlaylist($client, $master);

        $client->master(undef);
}
```

Slim::Player::Sync::unsync(), Slim/Player/Sync.pm (v5.3.1), 62–130 at 105–121

393. However, the temporary unsync is not recorded to the preferences file. The saveSyncPrefs() method is invoked with 1 for the $temp argument, which causes its syncgroupid to be retained ("Idling Sync") rather than deleted.

**Slim/Player/Sync.pm (v5.3.1)**

```
# when we unsync, we stop, but save settings first if we're doing at temporary unsync.
if ($temp) {
        saveSyncPrefs($client,defined $temp);
        Slim::Control::Command::execute($client, ["stop"]);
} else {
        Slim::Control::Command::execute($client, ["stop"]);
        saveSyncPrefs($client,defined $temp);
}
```

Slim::Player::Sync::unsync(), Slim/Player/Sync.pm (v5.3.1), 62–130 at 122–129

**Slim/Player/Sync.pm**

```
        if ($temp) {
                $::d_sync && msg("Idling Sync for $clientID\n");
        } else {
                $client->syncgroupid(undef);
                Slim::Utils::Prefs::clientDelete($client,'syncgroupid');
                $::d_sync && msg("Clearing Sync master for $clientID\n");
        }
```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 169–194 at 187–193

394. When a player is powered on, it is restored to its sync group.

**Slim/Player/Player.pm (v5.3.1)**

```
                                #check if there is a sync group to restore
                                Slim::Player::Sync::restoreSync($client);
```

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 230–231

**Slim/Player/Sync.pm (v5.3.1)**

```
# Restore Sync Operation
sub restoreSync {
        my $client = shift;
        my $masterID = (Slim::Utils::Prefs::clientGet($client,'syncgroupid'));
        if ($masterID && $client->power()) {
                my @players = Slim::Player::Client::clients();
                foreach my $other (@players) {
                        next if ($other eq $client);
                        next if (!$other->power());
                        my $othermasterID = Slim::Utils::Prefs::clientGet($other,'syncgroupid');
                        if ($othermasterID && ($othermasterID eq $masterID)) {
                                $client->syncgroupid($masterID);
                                $other->syncgroupid($masterID);
                                sync($client, $other);
                                last;
                        }
                }
        }
}
```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 196–214

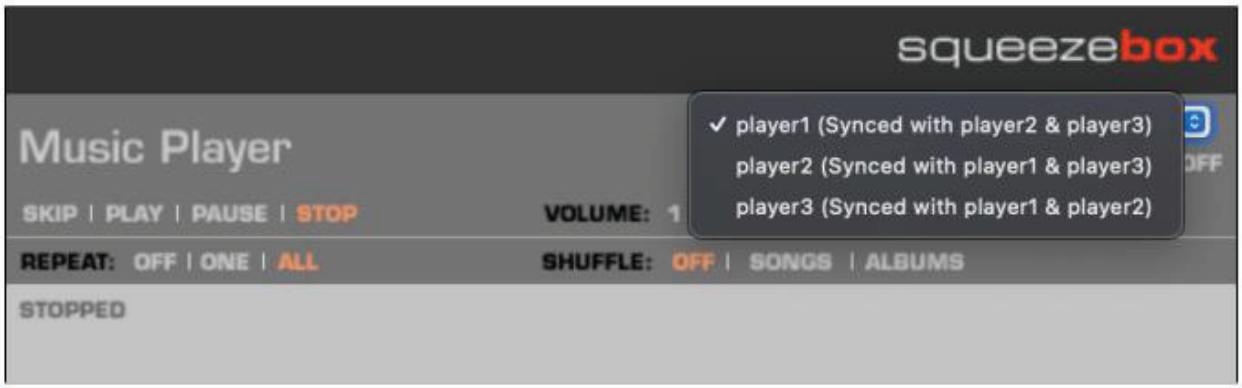
395. Consider the following set of three SoftSqueeze players, where player1, player2, and player3 are all synchronized together and player 1 is the master.

| Name | MAC (client ID) | IP | syncgroupid |
|---|---|---|---|
| player1 | bc:39:f3:c4:1e:29 | 192.168.136.129 | 482986368 |
| player2 | 0f:59:51:64:dc:d7 | 192.168.136.130 | 482986368 |
| player3 | 51:93:a5:ad:53:20 | 192.168.136.131 | 482986368 |

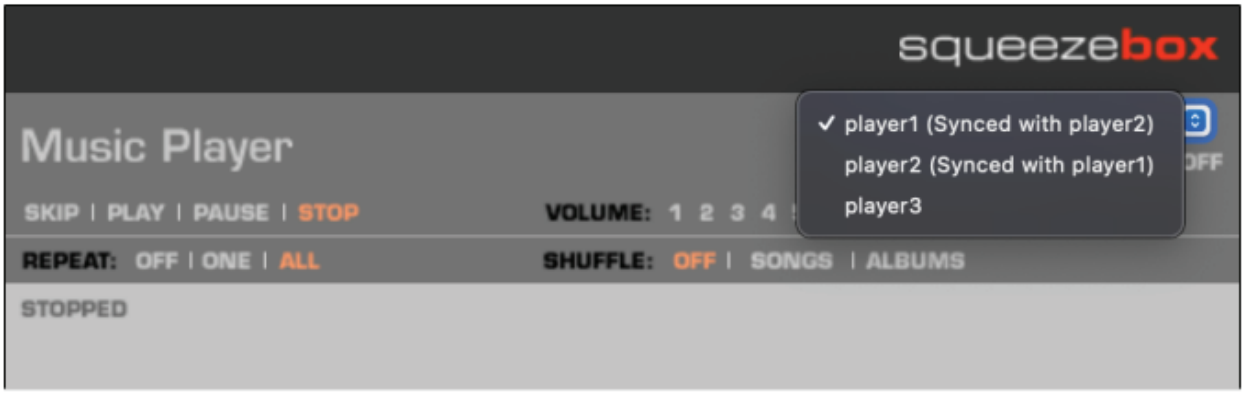
396. The preferences file (slimserver.conf) shows all players in the same sync group (482986368), as shown by the following 'grep' search of the preferences file.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

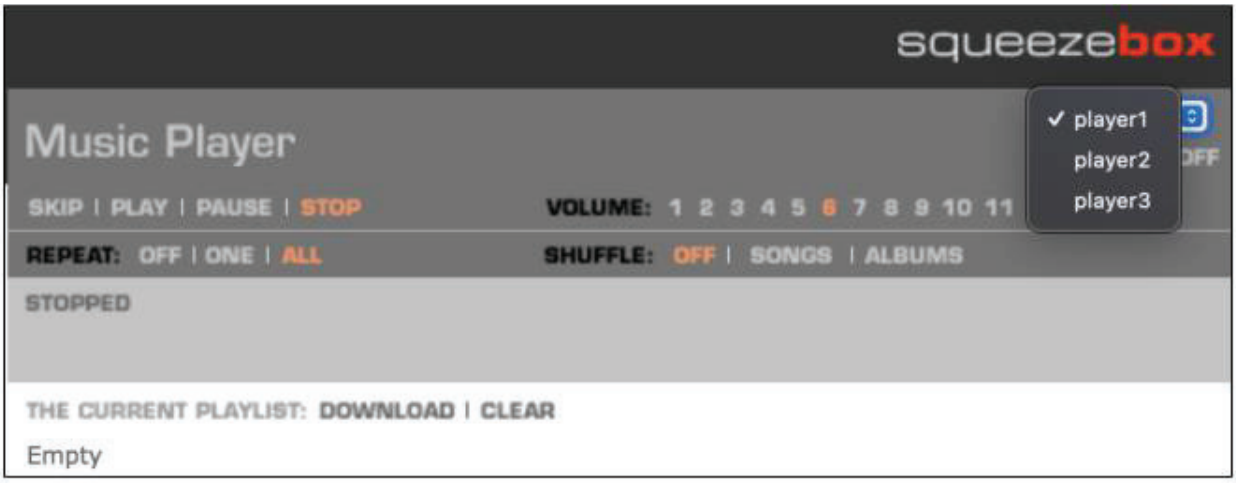
397. When all three players are powered on, the Web UI shows player1 synchronized with player2 and player3.




398. After pressing the "OFF" button in the Web UI's Music Player pane to power off player3, the Web UI shows player1 and player2 still synced, but player3 is unsynced.



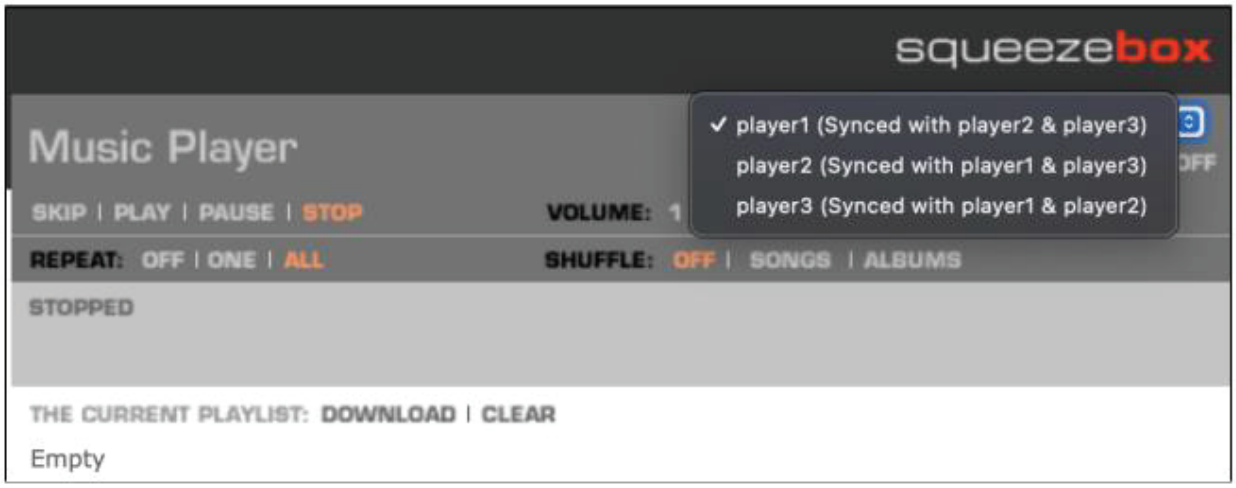

399. After pressing the "OFF" button in the Web UI's Music Player pane to power off player2, the Web UI shows all players as unsynced.




400. Although all players are treated as unsynced when only player1 is on, the preferences file still shows all three players in the same sync group.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

401. After powering on player2 and player3, the Web UI shows all three players synchronized again.




402. SlimServer v6.2.1 supports a 'serv' SlimProto message from SlimServer to player that tells a player to switch servers.

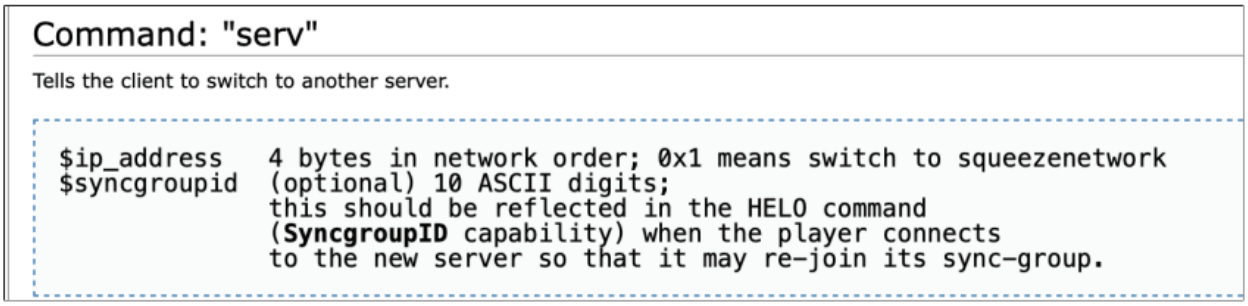
403. In SlimServer v6.2.1, the 'serv' SlimProto message is only used to tell the player to switch to SqueezeNetwork. The 'serv' message is sent with a host value of 1, representing SqueezeNetwork.

**Sim/Buttons/SqueezeNetwork.pm (v6.2.1)**

```
sub connectSqueezeNetwork {
        my $client = shift;

        # don't disconnect unless we're still in this mode.
        return unless ($client->param('squeezenetwork.connect'));

        if (clientIsCapable($client)) {
                my $host = pack('N',1);  # 1 is squeezenetwork
                $client->sendFrame('serv', \$host);

                # TODO: ensure client actually received the message

                # if message recieved, client has disconnected
                $client->forgetClient();
        }
}
```

Slim::Buttons::SqueezeNetwork::connectSqueezeNetwork(), Slim/Buttons/SqueezeNetwork.pm (v6.2.1), 90–105 at 97–98

404. The SlimProto TCP Protocol documentation on the current Squeezebox Wiki describes a later version of the 'serv' message.



Command: "serv"

Tells the client to switch to another server.

```
$ip_address   4 bytes in network order; 0x1 means switch to squeezenetwork
$syncgroupid  (optional) 10 ASCII digits;
              this should be reflected in the HELO command
              (SyncgroupID capability) when the player connects
              to the new server so that it may re-join its sync-group.
```

405. The function of the 'serv' command is described as: "Tells the client to switch to another server." The later version of 'serv' still supports the value of 1 to represent SqueezeNetwork but can also take a four-byte IP address to specify the server. In addition, the later command supports a '$syncgroupid' optional parameter to enable a player to re-join its sync group when the player connects to the new server. As discussed below, switching servers was possible prior to the serv command or the explanation above.

406. I now discuss an example use of the Squeezebox system that helps to illustrate the functionality of that system with respect to at least claim elements 1.6-1.10. I note that this example uses VMs and Softsqueeze, but that my testing of the hardware Squeezebox con firms that the same setup is available through Squeezeboxes, including my setup of SlimServers and Squeezeboxes over Wi-Fi.

407. In this example, all VMs are configured with a private network, which has network address 192.168.136.0/24.

| Name | Network MAC | Player MAC | IP |
|---|---|---|---|
| slimserver1 | 00:0C:29:A3:52:C6 | | 192.168.136.128 |
| slimserver2 | 00:0C:29:3B:B5:D2 | | 192.168.136.135 |
| player1 | 00:0C:29:45:6F:C2 | db:3a:52:e6:70:6b | 192.168.136.129 |
| player2 | 00:0C:29:83:57:01 | 19:1e:67:04:72:30 | 192.168.136.130 |
| player3 | 00:0C:29:B2:5E:60 | bc:2a:ae:6b:ab:ce | 192.168.136.131 |

408. I note that the Player MAC is determined by SoftSqueeze and is different from the network MAC of the computer running Softsqueeze.

409. We begin with a fresh installation of SlimServer v5.3.1 on all SlimServer VMs (slimserver1 and slimserver2), accomplished by uninstalling and then re-installing the SlimServer RPM.

```
rpm -e slimserver
rpm -ivh slimserver-5.3.1-1.noarch.rpm
```

410. Then set up Music Folder on slimserver1 and slimserver2 to /mnt/hgfs/Music.

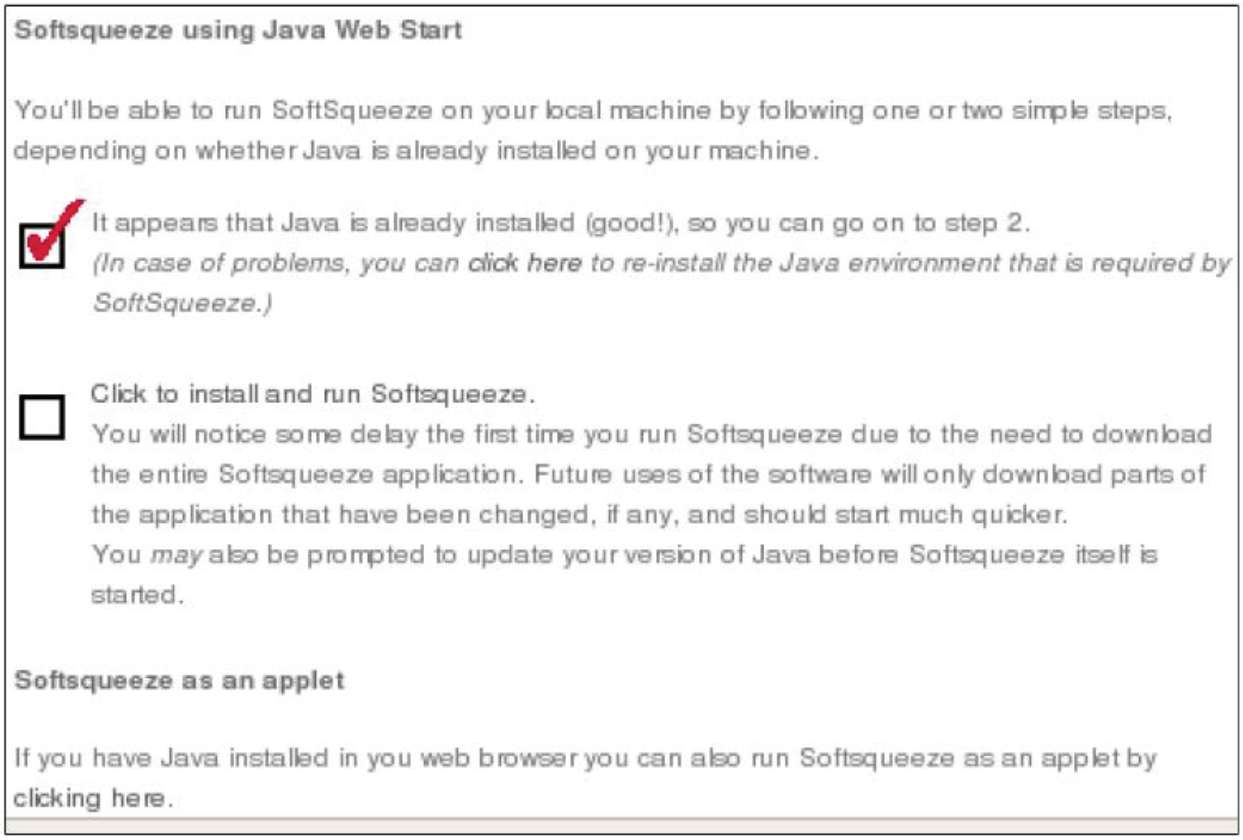
411. On slimserver1 and slimserver2, let the default server installations run automatically. The default configuration stores the preferences file in /etc/slimserver.conf and the log file in /tmp/slimserver.log.

412. On player VMs, remove all Java user preferences.

```
rm -rf ~/.java/.userPrefs
```

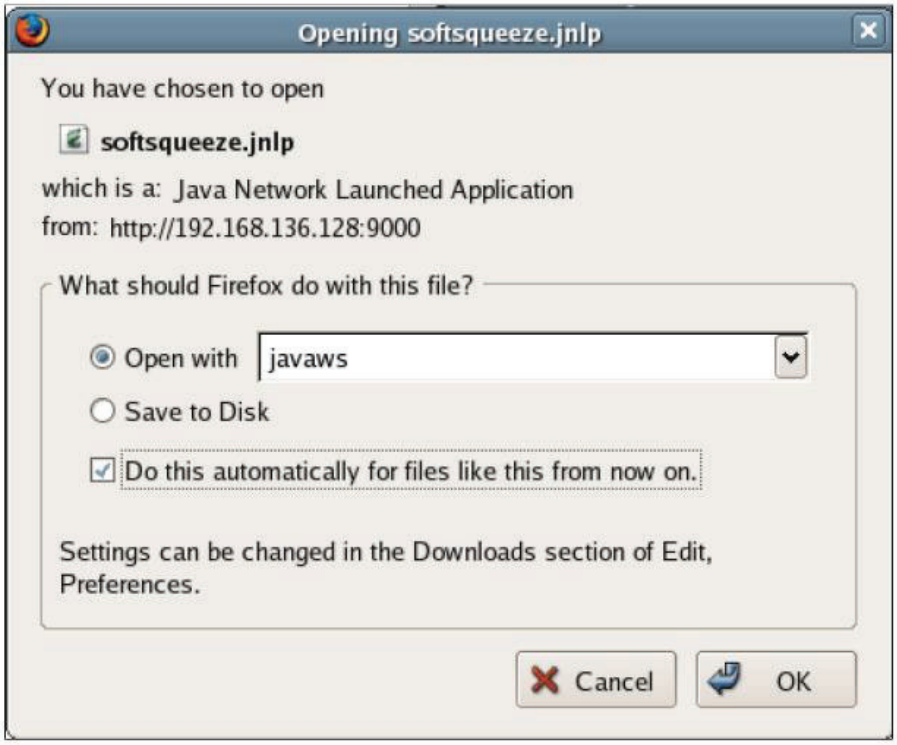
413. We follow the directions given by the SlimServer Web UI to launch SoftSqueeze from the web browser. This is equivalent to the direct invocation. We use the browser launch here to more directly follow the instructions given by SlimServer. I note that even though the player is being launched using one SlimServer (e.g., slimserver1), the player can stay running and

connect to other SlimServers (e.g., slimserver2). Alternatively, we can directly run the JAR file using "java -jar Softsqueeze.jar" (independently of any running SlimServer instance) as previously done.




http://<SLIMSERVER_ADDR>:9000/html/softsqueeze/index.html?player=0f%3A59%3A51%3A64%3Adc%3Ad7
Home / Softsqueeze
HTML/EN/html/softsqueeze/index.html

414. When prompted, use javaws ($JAVA_HOME/bin/javaws) to open the softsqueeze.jnlp file:



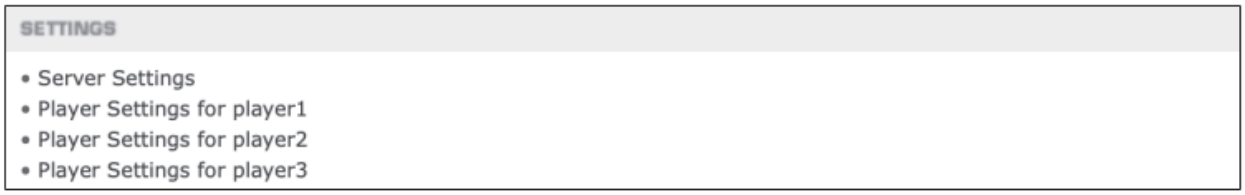

415. When prompted, select always trusting the application:

416. The SoftSqueeze player launches and connects to the server automatically (e.g., by discovery).

417. Using the Web UI, configure the player names. For example,

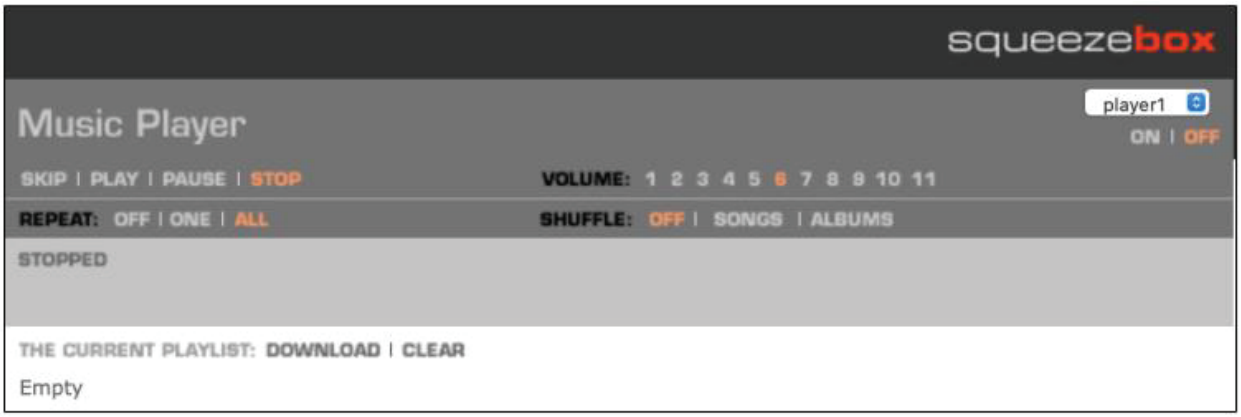
http://<SLIMSERVER_AP>:9000/setup.html?page=player&player=bc%3A2a%3Aae%3A6b%3Aab%3Ace&playerid=db%3A3a%3A52%3Ae6%3A70%3A6b
Home / Player Settings

418. After all player names have been configured, the Web UI shows the player names:




http://<SLIMSERVER_ADDR>:9000/index.html?player=db:3a:52:e6:70:6b
Home

419. Using the Web UI, press the "OFF" button to power off all players. For example, after turning off player1:




http://<SLIMSERVER_ADDR>:9000/index.html?player=db:3a:52:e6:70:6b
Home

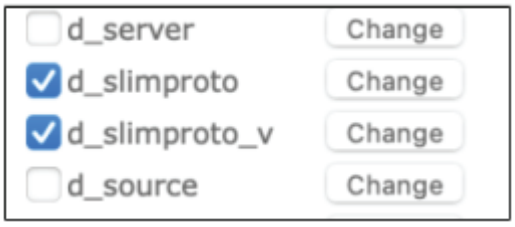
420. At this point, all players are persisted to slimserver1's preferences file with the defined names (player1, player2, and player3), power synchronization "off" (0), no sync groups, and power state "off" (0).

```
[vmuser@slimserver1 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 0
db:3a:52:e6:70:6b-syncPower = 0
```

421. I then define the first sync group on slimserver1. First I set up the logging and network trace for testing purposes. Stop slimserver1, clear the slimserver1 log file, and then start slimserver1. A new log file will be started in /tmp/slimserver.log

```
/etc/rc.d/init.d/slimserver stop
rm /tmp/slimserver.log
/etc/rc.d/init.d/slimserver start
```

422. When slimserver1 restarts, all connected players are powered on. Power all players off using the Web UI. In Home / Server Settings / Debugging, turn on debugging settings related to SlimProto. As a result, information about SlimProto protocol operation is logged to the log file (/tmp/slimserver.log).




423. Start a network trace.

```
tcpdump -i eth0 -s 0 -w slimserver1-01.pcap
```

424. We then define the first sync group. Press the right-arrow icon at the bottom-left of the SoftSqueeze player1 to show the remote control.

425. Press the power button to power player1 back up and allow for interaction. The player briefly shows the welcome screen and then transitions to the home screen.

426. Press up arrow to switch to the "Settings" menu item.

427. Press right arrow to select "Settings" and show the first Settings menu item ("Alarm Clock," setting 1 of 13).

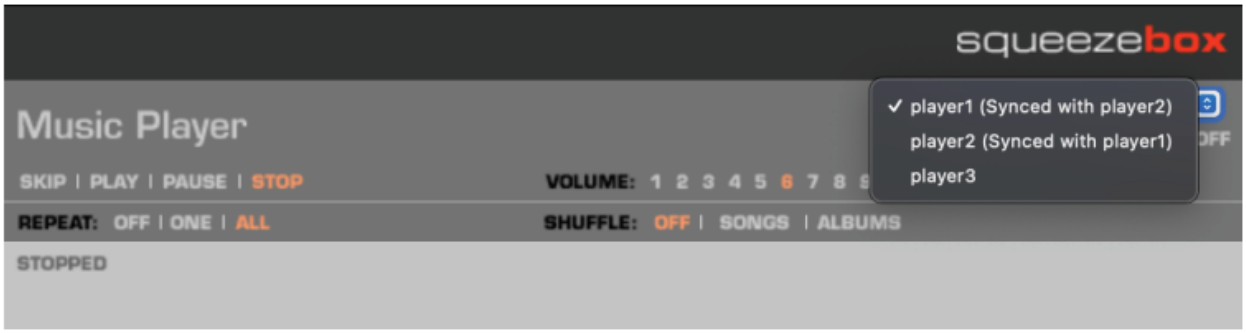
428. Press up arrow to switch to the "Synchronize" menu item (setting 13 of 13).

429. Press right arrow to select "Synchronize" and show a first synchronization choice (player3).

430. Press up arrow to show another synchronization choice (player2).

431. Press right arrow to select synchronization with player2. The screen changes to show that player2 is synced, with the menu choice now representing a cho ice to unsync. The screen change is animated, with the new screen pushing the old screen to the left.

432. The Web UI shows player1 and player2 synced.




433. slimserver1's preferences file shows player1 and player2 defined in the same sync group (675042355). player1 is powered on. player2 and player3 are powered off.

```
[vmuser@slimserver1 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
19:1e:67:04:72:30-syncgroupid = 675042355
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncgroupid = 675042355
```

434. As shown above, synchronizing player1 with player3 involves a series of remote control inputs and player1 screens. Both the remote control inputs and resulting screens involve SlimProto network messages between slimserver1 and player1.

- player1 sends "IR " SlimProto messages to slimserver1 for each IR events, such as button presses.
- slimserver1 sends "grfd" SlimProto messages to to player1 to display graphical screens

435. We first identify the IR SlimProto messages, which send IR codes from the player to the SlimServer. From the identified IR messages, the last "right arrow" IR packet represents the "right arrow" button press that initiates sync for player1 and player2. An IR packet is a client-to-server message, which consists of:

- Operation ("IR ") — offset 0, four bytes
- Data Packet Length — offset 4, four bytes

- Time — offset 8, four bytes
- Format — offset 12, one byte
- NoBits — offset 13, one byte
- IRCode — offset 14, four bytes

**Client -> Server Communications**

A command to the server consists of three parts:

1. The 1st 4 bytes specify the operation. The following operations are supported:
   - HELO
   - IR (note the two spaces after IR)
   - RESP
   - STAT
   - BYE!
2. The 2nd part (of four bytes) is simply the length of the data packet (in Network order).
3. The 3rd part is the data itself.

**"IR "** (Note the two spaces to make it up to 4 characters.)

One of these packets is recieved for each IR code recieved by the player.

**Data Length:** Fixed at 10 bytes.

**Format:**

| | | |
|---|---|---|
| Time | 4 bytes | Time since player startup in ticks (@1Khz) |
| Format | 1 byte | Code Format (ignored by the server for now - Code represents type of IR code - NEC, JVC or Sony) |
| NoBits | 1 byte | Length of IR Code (ignored by the server for now - 16 bits for JVC, 32 bits for NEC?) |
| IRCode | 4 bytes | the IR Code itself (upto 32 bits) |

http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html
HTML/EN/html/docs/slimproto.html

436. The "arrow_right" IR code is 7689d02f.

- arrow_right, IR/Slim_Devices_Remote.ir (v5.3.1), 21

437. The "right arrow" IR SlimProto packets are then identified using a WireShark display filter that selects for:

- destination port 3483 — from player to SlimServer
- data that begins with "IR " — the IR type

- data that has 0x7689d02f in the four bytes beginning at offset 14

438. which is expressed as:

```
tcp.dstport == 3483 && data.data[0:4] == "IR  " && data.data[14:4] == 76:89:d0:2f
```

439. There are six matching network packets, clustered in groups of two (954/966, 1427/1437, and 1894/1904). Within a cluster, the packets occur very close in time (e.g., within 0.1 seconds for 954/966). Because the clustered IR packets are very close in time, an IR cluster is consistent with a button repeat sequence as handled by the SlimServer IR code.

**Slim/Hardware/IR.pm (v5.3.1)**

```
        if (($irCodeBytes eq ($client->lastircodebytes())) #same button press as last one
                && ( ($client->irtimediff < $Slim::Hardware::IR::IRMINTIME) #within the minimum time to be
considered a repeat
                        || (($client->irtimediff < $client->irrepeattime * 2.02) #or within 2% of twice the
repeat time
                                && ($client->irtimediff > $client->irrepeattime * 1.98))) #indicating that a
repeat code was missed
                ) {
                holdCode($client,$irCodeBytes);
                repeatCode($client,$irCodeBytes);
                if (!$client->irrepeattime || ($client->irtimediff > 0 && $client->irtimediff < $client-
>irrepeattime)) {
                        #repeat time not yet set or last time diff less than current estimate
                        #of repeat time (excluding time diffs less than 0, from out of order packets)
                        $client->irrepeattime($client->irtimediff)
                }
```

Slim::Hardware::IR::processIR(), Slim/Hardware/IR.pm (v5.3.1), 334–393 at 365–376

440. The three clusters represent the three "right arrow" presses performed in the synchronization flow described above. The first "right arrow" selects the "Settings" menu item, the second "right arrow" selects the "Synchronize" menu item, and the third "right arrow" selects the sync group to join. The last IR packet cluster (1894 at 20:48:16.074074; 1904 at 20:48:16.164760) thereby represents the "arrow_right" IR code that initiates the sync.

tcp.dstport == 3483 && data.data[0:4] == "IR  " && data.data[14:4] == 76:89:d0:2f

Interface Device All advertising devices Key Legacy Passkey Value Adv Hop

| No. | Time | Source | Destination | Protocol | Source Port | Destination Port | Length |
|---|---|---|---|---|---|---|---|
| 954 | 20:47:26.486498 | 192.168.136.129 | 192.168.136.128 | TCP | 32866 | 3483 | 84 |
| 966 | 20:47:26.583292 | 192.168.136.129 | 192.168.136.128 | TCP | 32866 | 3483 | 84 |
| 1427 | 20:47:51.009815 | 192.168.136.129 | 192.168.136.128 | TCP | 32866 | 3483 | 84 |
| 1437 | 20:47:51.101712 | 192.168.136.129 | 192.168.136.128 | TCP | 32866 | 3483 | 84 |
| 1894 | 20:48:16.074074 | 192.168.136.129 | 192.168.136.128 | TCP | 32866 | 3483 | 84 |
| 1904 | 20:48:16.164760 | 192.168.136.129 | 192.168.136.128 | TCP | 32866 | 3483 | 84 |

441. The slimserver1 log file is consistent with the network trace (modulo a slight time skew between the network stack timestamp and the application logging timestamp).

```
[vmuser@slimserver1 example]$ grep 'op IR  ' slimserver-01.log
2022-06-21 20:46:58.1073 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:46:58.2000 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:11.1490 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:11.2416 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:26.4876 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:26.5846 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:38.8061 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:38.9095 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:51.0111 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:47:51.1028 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:02.0107 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:02.1029 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.0756 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.1657 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
```

442. After packet 1894 (20:48:16.074074), SlimServer responds with a series of eight 'grfd' command packets to the player animating the new screen pushing the old screen off to the left.

**Slim/Player/SqueezeboxG (v5.3.1)**

```
# push the old screen off the left side
sub pushLeft {
        my $client = shift;
        my $start = shift;
        my $end = shift;

        my $startbits = $client->render($start);
        my $endbits = $client->render($end);

        my $allbits = $$startbits . $$endbits;

        $client->killAnimation();
        $client->pushUpdate([\$allbits, 0, $screensize / 8, $screensize,  0.025]);
}
```

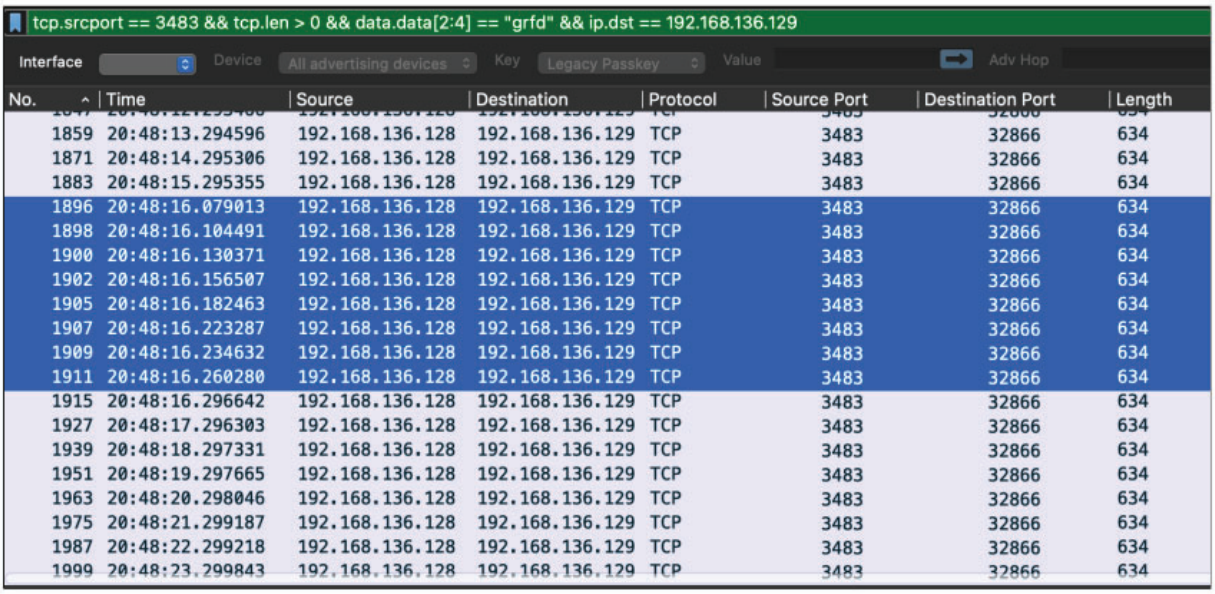
Slim::Player::SqueezeboxG::pushLeft(), Slim/Player/SqueezeboxG.pm (v5.3.1), 401–414 at 413
Slim::Player::SqueezeboxG::pushUpdate(), Slim/Player/SqueezeboxG.pm (v5.3.1), 447–464 at 459

Slim::Player::SqueezeboxG::drawFrameBuf(), Slim/Player/SqueezeboxG.pm (v5.3.1), 368–382 at 380

443. Each such packet begins with a two-byte length field and a four-byte command field. The 'grfd' are identified in the network trace using a WireShark display filter that selects for:

source port 3483 — from SlimServer to player
TCP length > 0 — to filter out pure acknowledgement packets
command code 'grfd'
destination 192.168.136.129 (player1)

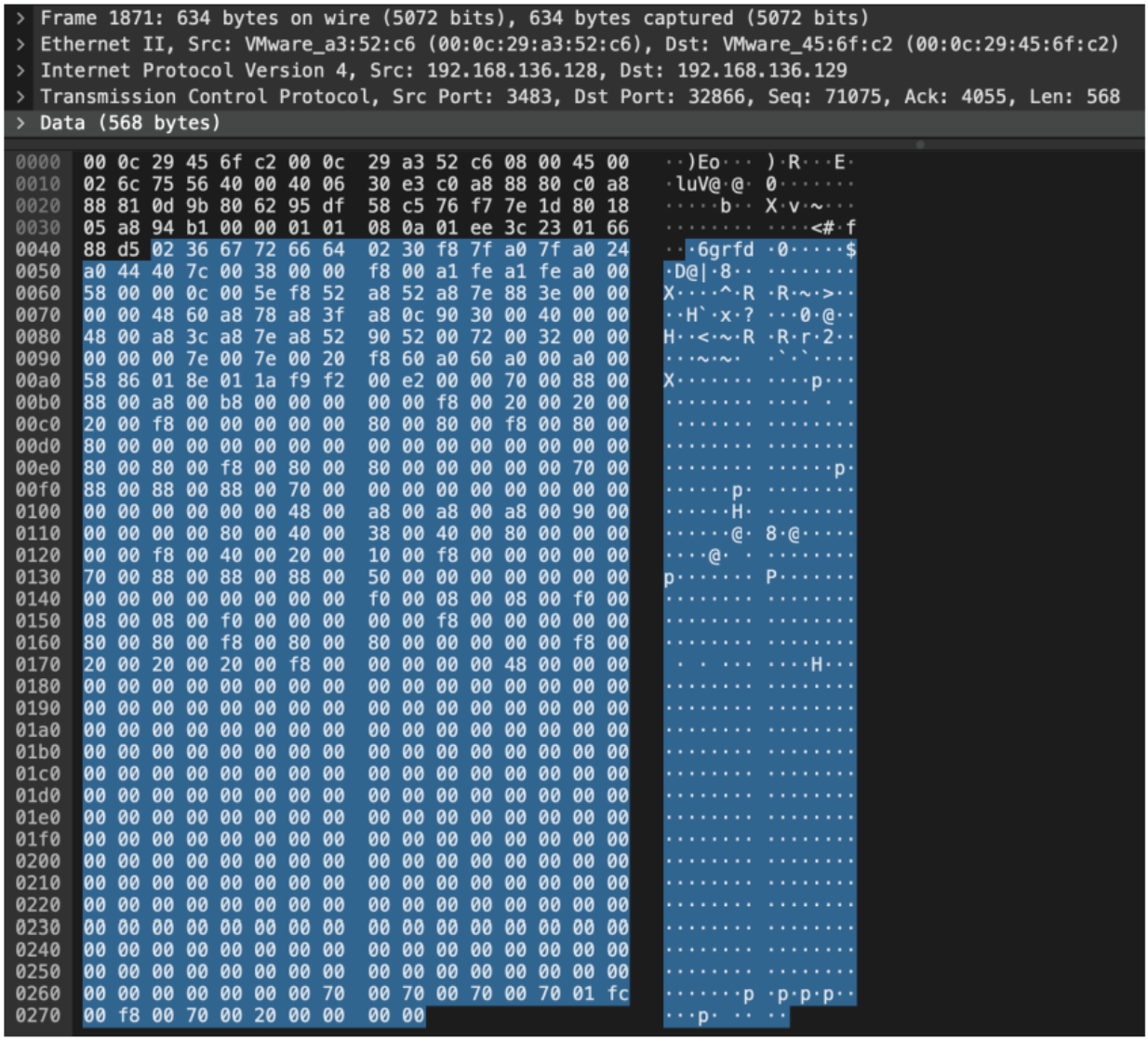
```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129
```




| No. | Time | Source | Destination | Protocol | Source Port | Destination Port | Length |
|---|---|---|---|---|---|---|---|
| 1859 | 20:48:13.294596 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1871 | 20:48:14.295306 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1883 | 20:48:15.295355 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1896 | 20:48:16.079013 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1898 | 20:48:16.104491 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1900 | 20:48:16.130371 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1902 | 20:48:16.156507 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1905 | 20:48:16.182463 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1907 | 20:48:16.223287 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1909 | 20:48:16.234632 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1911 | 20:48:16.260280 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1915 | 20:48:16.296642 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1927 | 20:48:17.296303 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1939 | 20:48:18.297331 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1951 | 20:48:19.297665 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1963 | 20:48:20.298046 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1975 | 20:48:21.299187 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1987 | 20:48:22.299218 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |
| 1999 | 20:48:23.299843 | 192.168.136.128 | 192.168.136.129 | TCP | 3483 | 32866 | 634 |

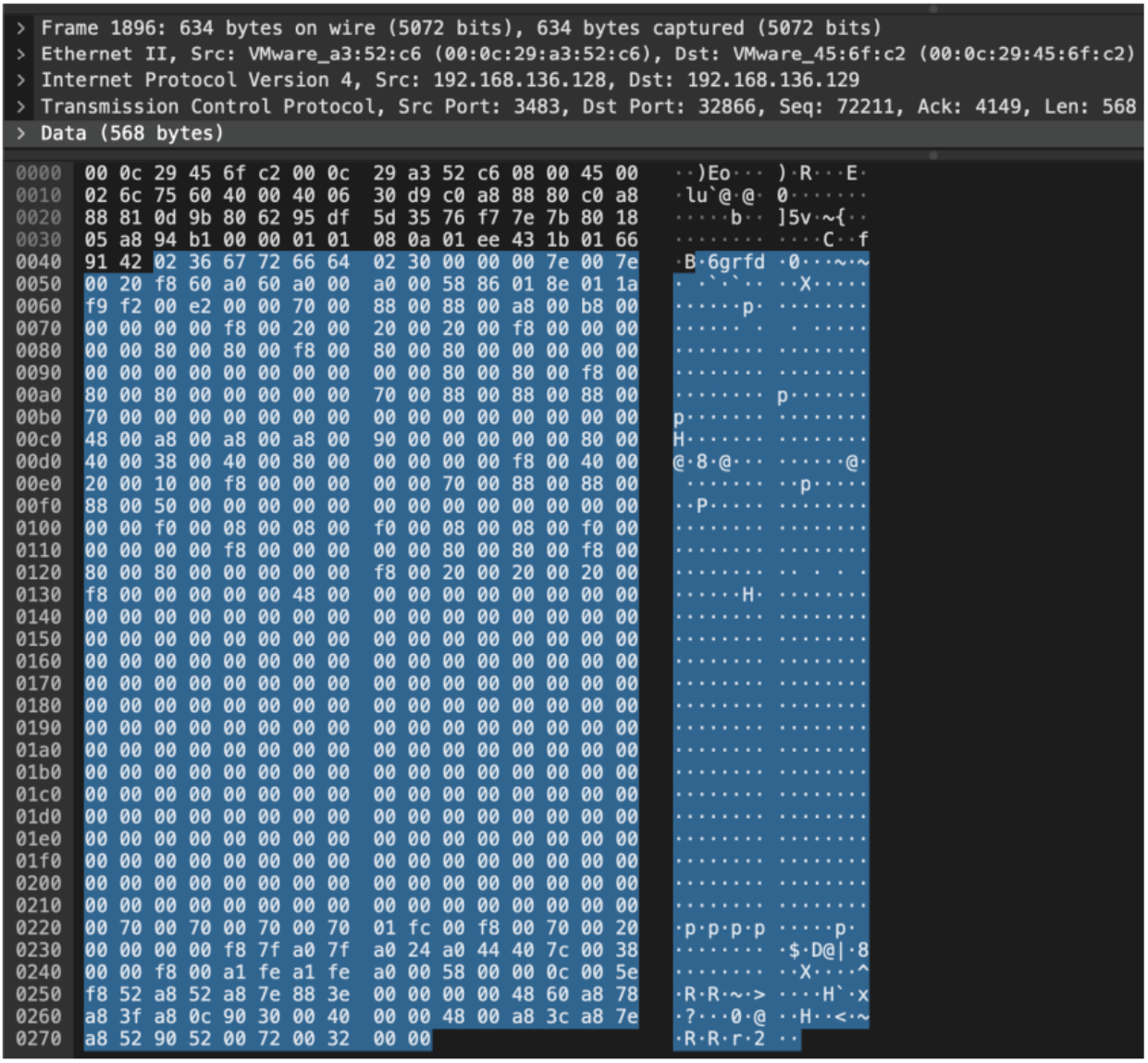
444. The server sends a series of eight 'grfd' packets to player1 (192.168.136.129) starting at packet 1896 (20:48:16.079013) through packet 1911 (20:48:16.260280) with distinct contents, consistent with the "push left" animation. Packets 1444 (20:47:51.195152) through 1883 (20:48:15.295355) have identical 'grfd' payload, consistent with a repeated pre-sync screen:

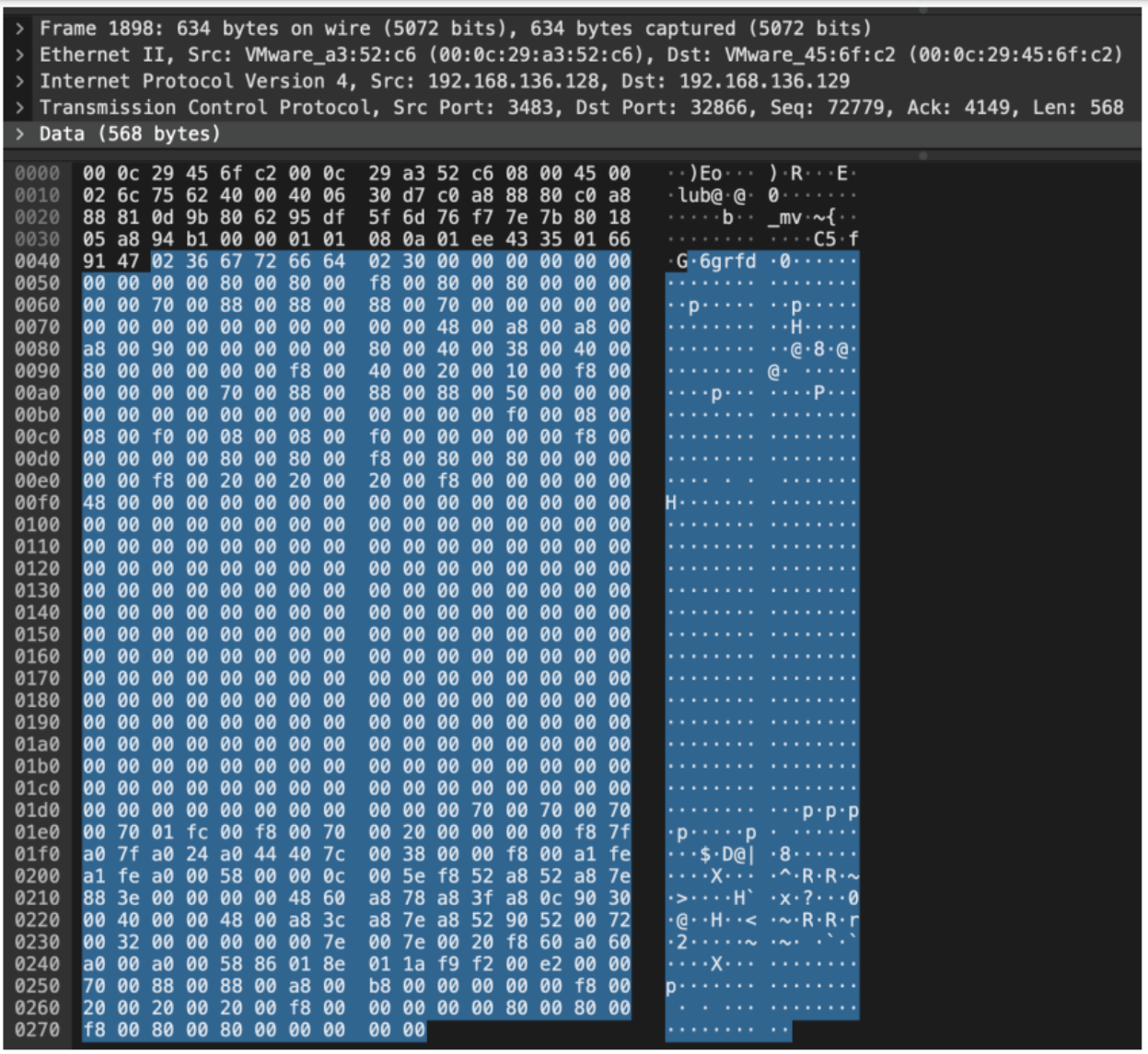
445. For example, packet 1871 (20:48:14.295306):

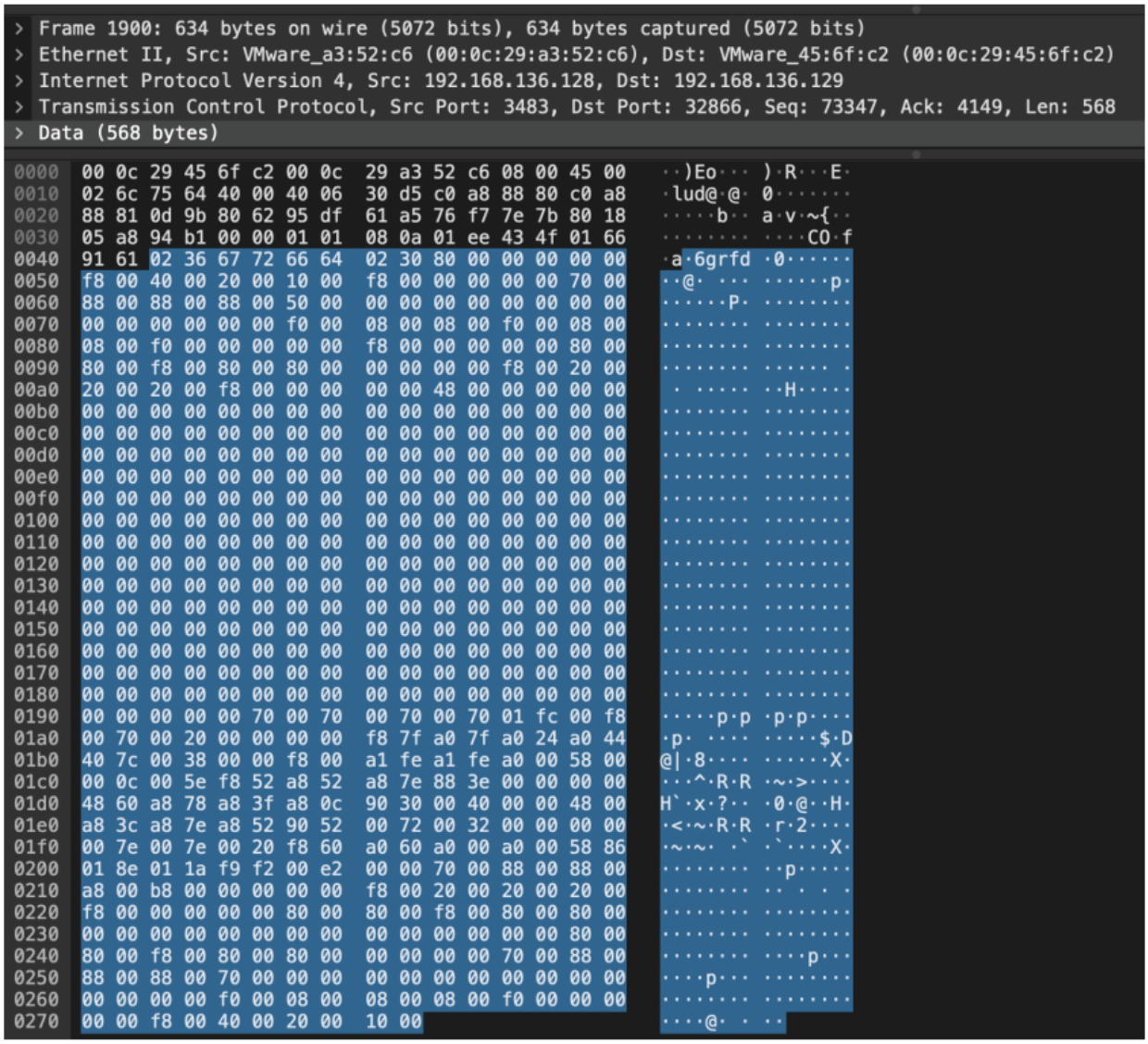



446. Has the same 'grfd' payload as packet 1883 (20:48:15.295355):

447. The payload for packets 1896 through 1911 differ, shifting off old content and shifting in new content.

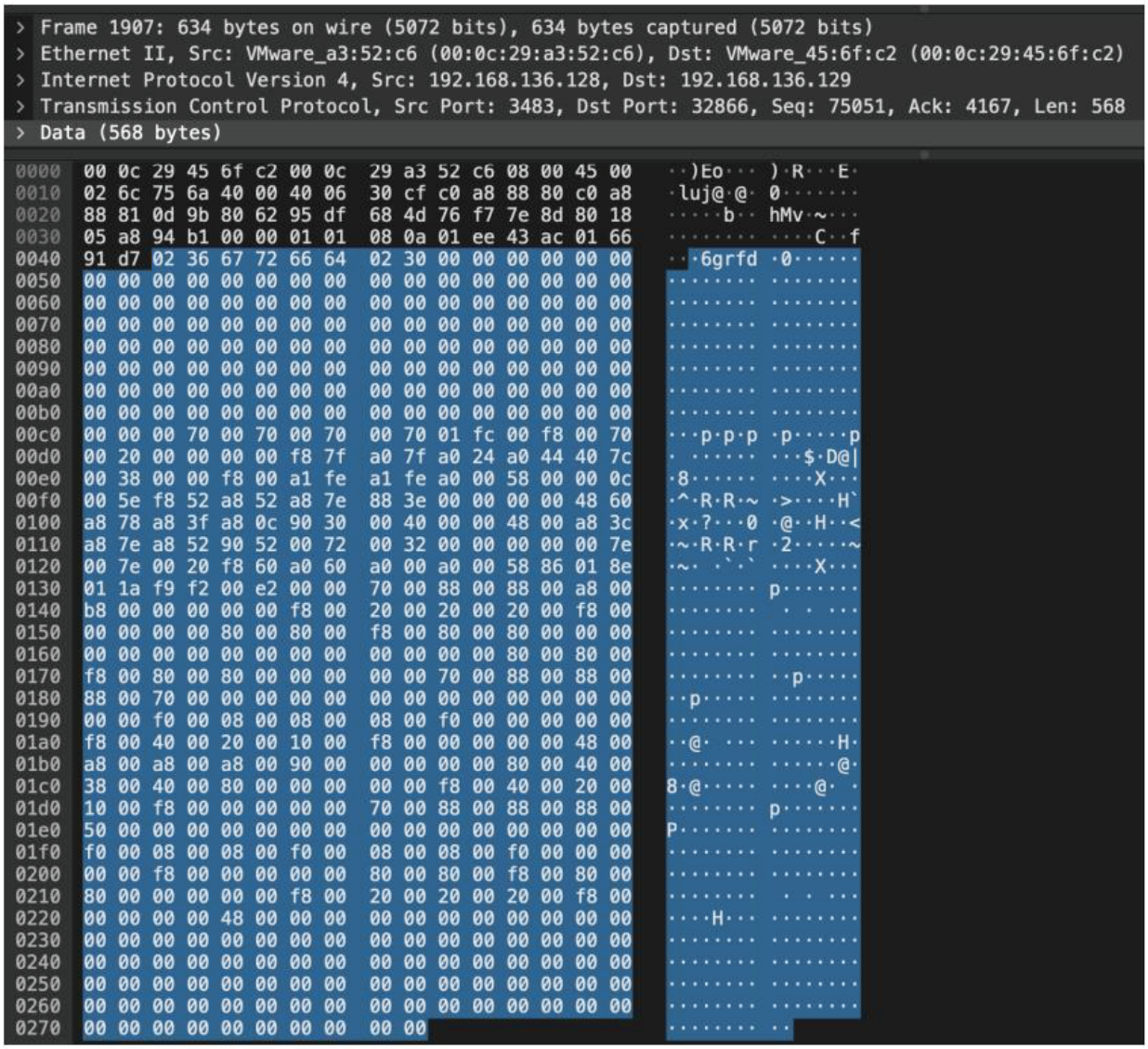

> Frame 1896: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 72211, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 60 40 00 40 06 30 d9 c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 5d 35 76 f7 7e 7b 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 1b 01 66
0040 91 42 02 36 67 72 66 64 02 30 00 00 00 7e 00 7e
0050 00 20 f8 60 a0 60 a0 00 a0 00 58 86 01 8e 01 1a
0060 f9 f2 00 e2 00 00 70 00 88 00 88 00 a8 00 b8 00
0070 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00
0080 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 80 00 80 00 f8 00
00a0 80 00 80 00 00 00 00 00 70 00 88 00 88 00 88 00
00b0 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00
00d0 40 00 38 00 40 00 80 00 00 00 00 00 f8 00 40 00
00e0 20 00 10 00 f8 00 00 00 00 00 70 00 88 00 88 00
00f0 88 00 50 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00
0110 00 00 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00
0120 80 00 80 00 00 00 00 00 f8 00 20 00 20 00 20 00
0130 f8 00 00 00 00 00 48 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0220 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20
0230 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38
0240 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e
0250 f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78
0260 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e
0270 a8 52 90 52 00 72 00 32 00 00

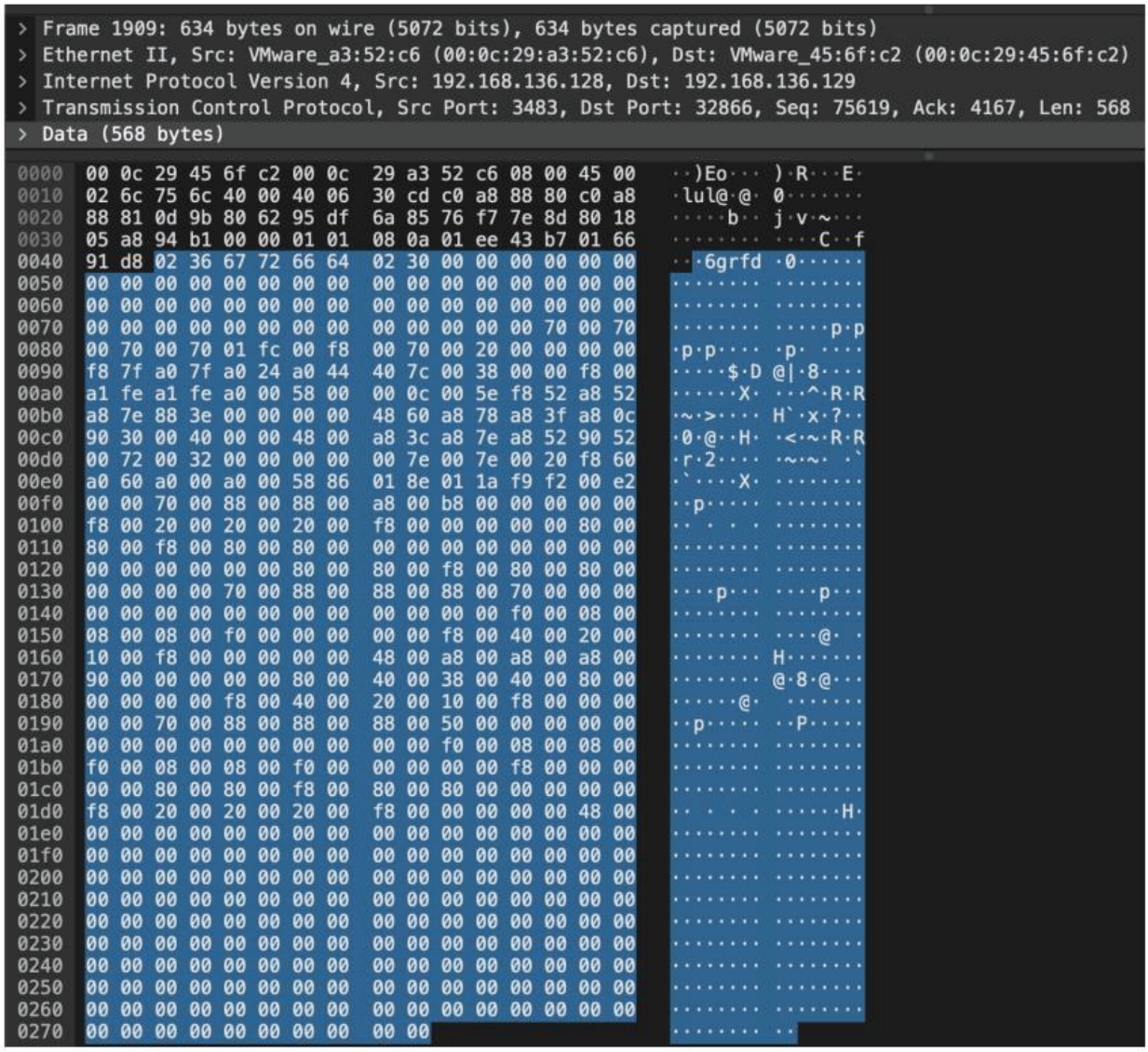

> Frame 1898: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 72779, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 62 40 00 40 06 30 d7 c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 5f 6d 76 f7 7e 7b 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 35 01 66
0040 91 47 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00
0060 00 00 70 00 88 00 88 00 88 00 70 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 48 00 a8 00 a8 00
0080 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00
0090 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00
00a0 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00
00c0 08 00 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00
00d0 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00
00e0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00
00f0 48 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 00 00 00 70 00 70 00 70
01e0 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f
01f0 a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe
0200 a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e
0210 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30
0220 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72
0230 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60
0240 a0 00 a0 00 58 86 01 8e 01 1a f9 f2 00 e2 00 00
0250 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00
0260 20 00 20 00 20 00 f8 00 00 00 00 00 80 00 80 00
0270 f8 00 80 00 80 00 00 00 00 00

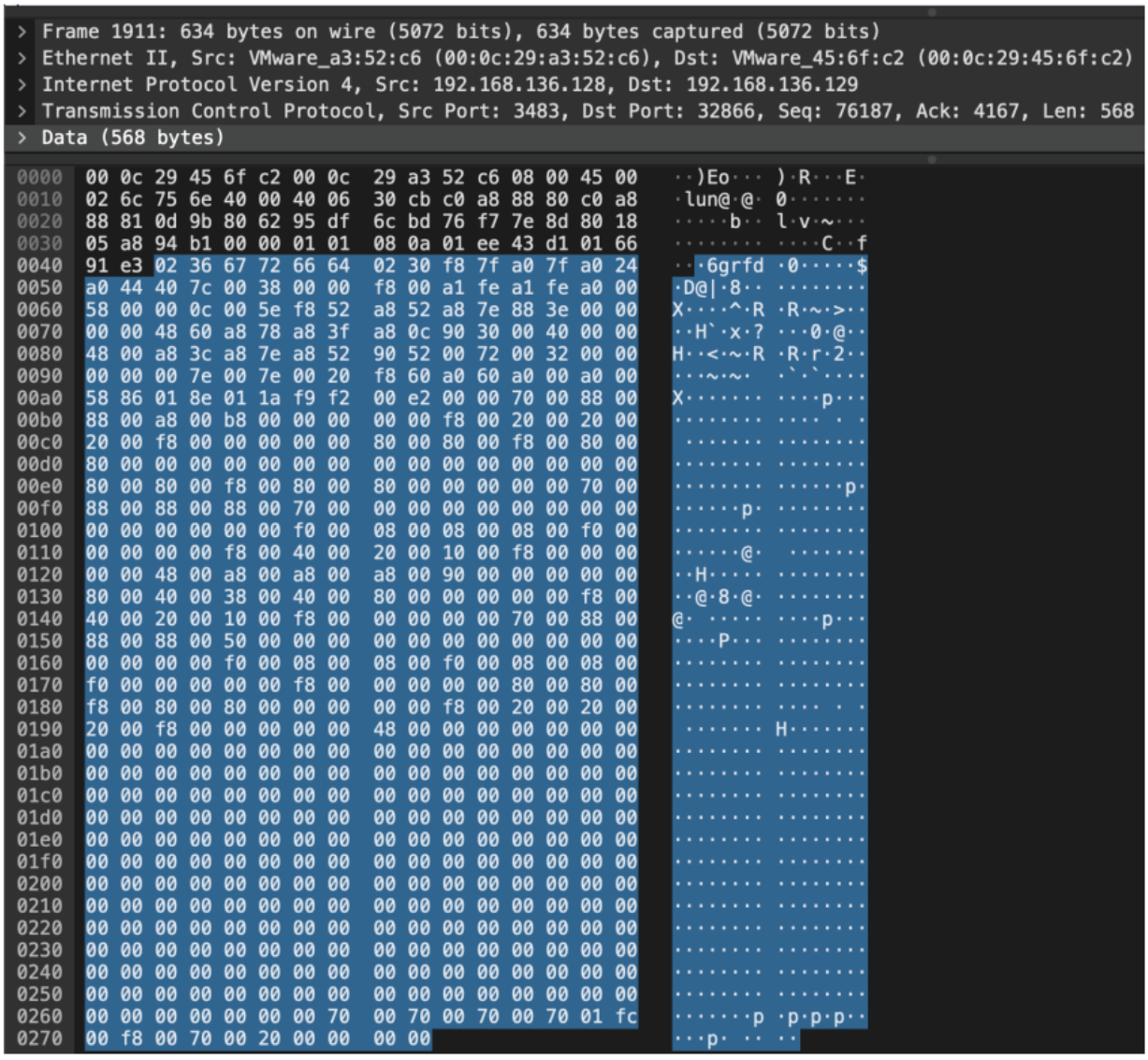

> Frame 1900: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 73347, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 64 40 00 40 06 30 d5 c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 61 a5 76 f7 7e 7b 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 4f 01 66
0040 91 61 02 36 67 72 66 64 02 30 80 00 00 00 00 00
0050 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00
0060 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00
0080 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00
0090 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00
00a0 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8
01a0 00 70 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44
01b0 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00
01c0 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00
01d0 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00
01e0 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 00 00
01f0 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 86
0200 01 8e 01 1a f9 f2 00 e2 00 00 70 00 88 00 88 00
0210 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00
0220 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 80 00
0240 80 00 f8 00 80 00 80 00 00 00 00 00 70 00 88 00
0250 88 00 88 00 70 00 00 00 00 00 00 00 00 00 00 00
0260 00 00 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00
0270 00 00 f8 00 40 00 20 00 10 00

> Frame 1902: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 73915, Ack: 4149, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 66 40 00 40 06 30 d3 c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 63 dd 76 f7 7e 7b 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 69 01 66
0040 91 7b 02 36 67 72 66 64 02 30 80 00 f8 00 80 00
0050 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00
0060 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 70
0150 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00
0160 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00
0170 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52
0180 a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78 a8 3f
0190 a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52
01a0 90 52 00 72 00 32 00 00 00 00 00 7e 00 7e 00 20
01b0 f8 60 a0 60 a0 00 a0 00 58 86 01 8e 01 1a f9 f2
01c0 00 e2 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00
01d0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00
01e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 80 00 80 00 f8 00 80 00
0200 80 00 00 00 00 00 70 00 88 00 88 00 88 00 70 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 f0 00
0220 08 00 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00
0230 20 00 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00
0240 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00
0250 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00
0260 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00
0270 00 00 00 00 00 00 00 00 00 00

> Frame 1905: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 74483, Ack: 4167, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 68 40 00 40 06 30 d1 c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 66 15 76 f7 7e 8d 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 83 01 66
0040 91 9d 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 70 00 70 00 70 00 70
0110 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f a0 7f
0120 a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe
0130 a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e
0140 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40
0150 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32
0160 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00
0170 a0 00 58 86 01 8e 01 1a f9 f2 00 e2 00 00 70 00
0180 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00
0190 20 00 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00
01a0 80 00 80 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00
01c0 70 00 88 00 88 00 88 00 70 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 08 00
01e0 f0 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00
01f0 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00
0200 00 00 80 00 40 00 38 00 40 00 80 00 00 00 00 00
0210 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00
0220 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00
0230 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00
0240 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00
0250 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00
0260 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00
0270 00 00 00 00 00 00 00 00 00 00


> Frame 1907: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 75051, Ack: 4167, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 6a 40 00 40 06 30 cf c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 68 4d 76 f7 7e 8d 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 ac 01 66
0040 91 d7 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70
00d0 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c
00e0 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c
00f0 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60
0100 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c
0110 a8 7e a8 52 90 52 00 72 00 32 00 00 00 00 00 7e
0120 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 86 01 8e
0130 01 1a f9 f2 00 e2 00 00 70 00 88 00 88 00 a8 00
0140 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00
0150 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 80 00 80 00
0170 f8 00 80 00 80 00 00 00 00 00 70 00 88 00 88 00
0180 88 00 70 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00 00 00
01a0 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 48 00
01b0 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00 40 00
01c0 38 00 40 00 80 00 00 00 00 00 f8 00 40 00 20 00
01d0 10 00 f8 00 00 00 00 00 70 00 88 00 88 00 88 00
01e0 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00 00 00
0200 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00
0210 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00
0220 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 00
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0270 00 00 00 00 00 00 00 00 00 00


> Frame 1909: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_a3:52:c6 (00:0c:29:a3:52:c6), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.128, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32866, Seq: 75619, Ack: 4167, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 a3 52 c6 08 00 45 00
0010 02 6c 75 6c 40 00 40 06 30 cd c0 a8 88 80 c0 a8
0020 88 81 0d 9b 80 62 95 df 6a 85 76 f7 7e 8d 80 18
0030 05 a8 94 b1 00 00 01 01 08 0a 01 ee 43 b7 01 66
0040 91 d8 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 70 00 70
0080 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00
0090 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00
00a0 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52
00b0 a8 7e 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c
00c0 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52
00d0 00 72 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60
00e0 a0 60 a0 00 a0 00 58 86 01 8e 01 1a f9 f2 00 e2
00f0 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00
0100 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 80 00
0110 80 00 f8 00 80 00 80 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00
0130 00 00 00 00 70 00 88 00 88 00 88 00 70 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00
0150 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00 20 00
0160 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00 a8 00
0170 90 00 00 00 00 00 80 00 40 00 38 00 40 00 80 00
0180 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00
0190 00 00 70 00 88 00 88 00 88 00 50 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 f0 00 08 00 08 00
01b0 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00 00 00
01c0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00
01d0 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 48 00
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0270 00 00 00 00 00 00 00 00 00 00




448. Packets 1915 through 2086 (the last 'grfd' packet in the trace) contain the same 'grfd' payload as packet 1911. For example, packet 1915:

449. The slimserver1 log entries are consistent with the network trace. Filtering the slimserver1 log shows player-to-server IR codes and server-to-player SlimProto frames:

```
grep -P 'op IR  |sending squeezebox frame' slimserver-01.log
```

450. The filtered results show a last IR packet cluster at 20:48:16.0756 and 20:48:16.1657, representing the "right arrow" that initiates the sync. There are eight 'grfd' messages following the 20:48:16.0756 IR packet, with the eighth 'grfd' packet at 20:48:16.2601.

451. The timestamp for that eighth 'grfd' packet (20:48:16.2601) is consistent with the network timestamp for packet 1911 (20:48:16.260280), modulo skew between the application logging and network timestamps.

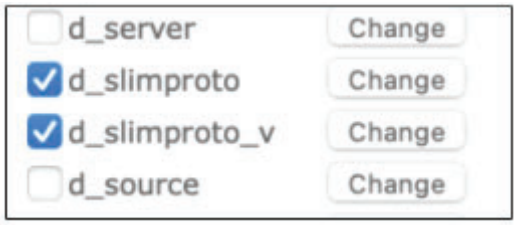
```
2022-06-21 20:48:15.2952 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:15.3068 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.0756 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.0789 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1043 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1302 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1564 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.1657 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9ddba54)
2022-06-21 20:48:16.1823 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2083 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2344 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2601 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2872 sending squeezebox frame: grfd, length: 562
2022-06-21 20:48:16.2965 sending squeezebox frame: grfd, length: 562
```

452. Consequently, packet 1911 (20:48:16.260280) represents the 'grfd' message sent from slimserver1 to player1 with the post-sync screen:

453. We now define the second sync group on slimserver2. To set up the loggin and network trace, we stop slimserver2, clear the slimserver2 log file, and then start slimserver2. A new log file will be started in /tmp/slimserver.log.

```
/etc/rc.d/init.d/slimserver stop
rm /tmp/slimserver.log
/etc/rc.d/init.d/slimserver start
```

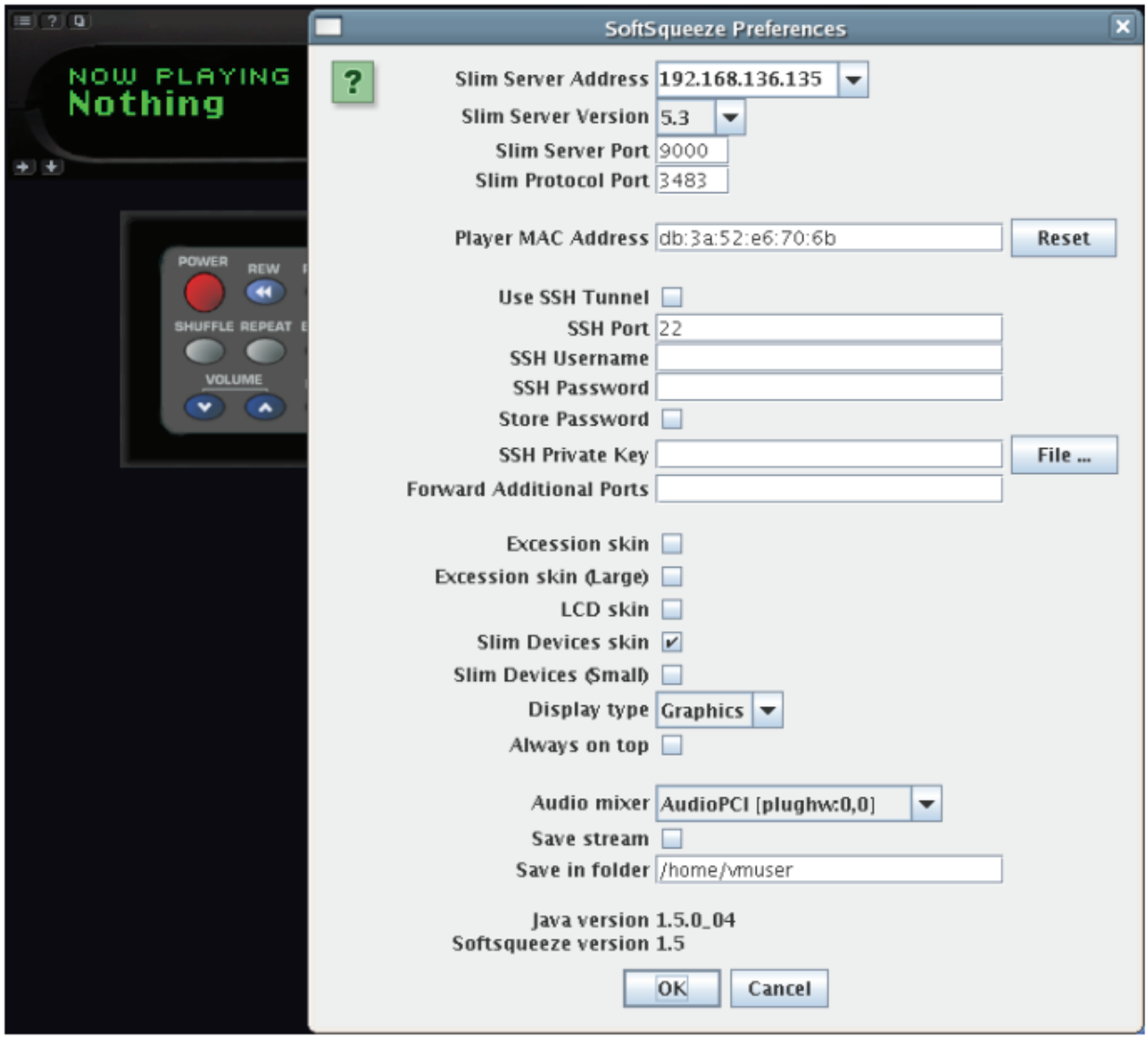
454. In Home / Server Settings / Debugging, turn on debugging settings related to SlimProto. As a result, information about SlimProto protocol operation is logged to the log file (/tmp/slimserver.log).




455. Start a network trace.

```
tcpdump -i eth0 -s 0 -w slimserver2-01.pcap
```

456. We then switch to slimserver2. On each player, press the settings icon at the top-left of the SoftSqueeze player to bring up the SoftSqueeze settings dialog. Configure the server to be slimserver2 (192.168.136.135). For example (player1):




457. Do the same for player2 and player3. There is no need to power on player2 and player3 first. The SoftSqueeze settings can be configured without powering the players on. However, the players automatically power on when connected to slimserver2.

458. The Web UI for slimserver2 shows the players with IP addresses but no names.

459. Configure the player names for player1, player2, and player3 as with slimserver1. For example:

460. Use the Web UI to power off all players. At this point, all players are persisted to slimserver1's preferences file with the defined names (player1, player2, and player3), power synchronization "off" (0), no sync groups, and power state "off" (0).

```
[vmuser@slimserver2 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 0
db:3a:52:e6:70:6b-syncPower = 0
```

461. We can now define the second synchrony group. Press the power button to power player1 back up and allow for interaction. The player briefly shows the welcome screen and then transitions to the home screen.

462. Press up arrow to switch to the "Settings" menu item.

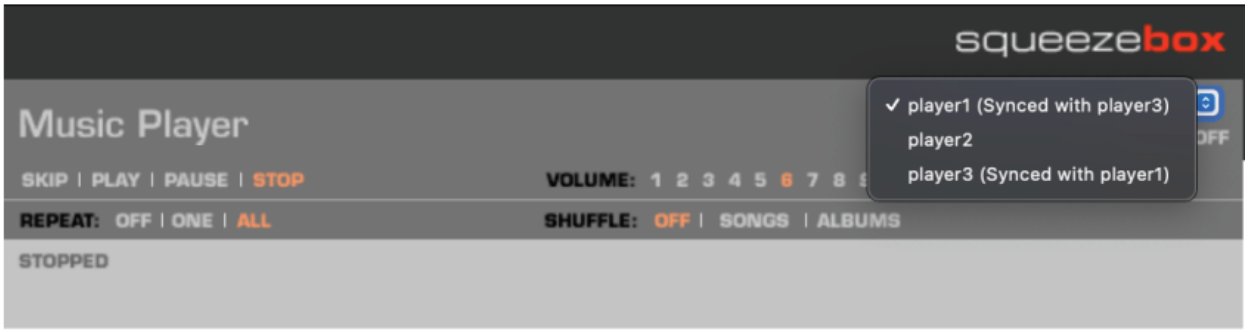
463. Press right arrow to select "Settings" and show the first Settings menu item ("Alarm Clock," setting 1 of 13).

464. Press up arrow to switch to the "Synchronize" menu item (setting 13 of 13).

465. Press right arrow to select "Synchronize" and show a first synchronization choice (player3).

466. Press right arrow to select synchronization with player3. The screen changes to show that player3 is synced, with the menu choice now representing a choice to unsync.

467. The Web UI shows player1 and player3 synced. (Note: this screen shows player1 and player3 as synced even though player3 is off. This may be because synchronization was configured while player3 is off.)




468. slimserver2's preferences file shows player1 and player3 defined in the same sync group (361890235). player1 is powered on. player2 and player3 are powered off.

```
[vmuser@slimserver2 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 361890235
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncgroupid = 361890235
```

469. We can now discuss the network messages for defining the second sync group. As shown above, synchronizing player1 with player3 involves a series of remote control inputs and player1 screens. Both the remote control inputs and resulting screens involve SlimProto network messages between slimserver1 and player1.

- player1 sends "IR " SlimProto messages to slimserver1 for each IR events, such as button presses.
- slimserver1 sends "grfd" SlimProto messages to to player1 to display graphical screens

470. We first identify the IR SlimProto messages, which send IR codes from the player to the SlimServer. From the identified IR messages, the last "right arrow" IR packet represents the "right arrow" button press that initiates sync for player1 and player3. The "right arrow" IR SlimProto packets are then identified using a WireShark display filter that selects for:

destination port 3483 — from player to SlimServer
data that begins with "IR " — the IR type
data that has 0x7689d02f in the four bytes beginning at offset 14

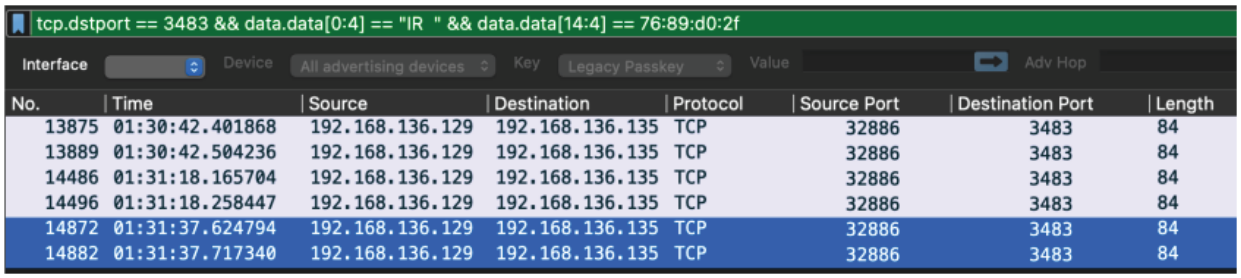
471. Which is expressed as:

```
tcp.dstport == 3483 && data.data[0:4] == "IR  " && data.data[14:4] == 76:89:d0:2f
```

472. There are six matching network packets, clustered in groups of two (13875/13889, 14486/14496, and 14872 /14882). Within a cluster, the packets occur very close in time (e.g., within 0.1 seconds for 13875/13889). Because the clustered IR packets are very close in time, an IR cluster is consistent with a button repeat sequence as handled by the SlimServer IR code.

Slim::Hardware::IR::processIR(), Slim/Hardware/IR.pm (v5.3.1), 334–393 at 365–376

473. The three clusters represent the three "right arrow" presses performed in the synchronization flow described above. The first "right arrow" selects the "Settings" menu item, the second "right arrow" selects the "Synchronize" menu item, and the third "right arrow" selects the sync group to join. The last IR packet cluster (14872 at 01:13:37.624794; 14882 at 01:31:37.717340) thereby represents the "arrow_right" IR code that initiates the sync




| No. | Time | Source | Destination | Protocol | Source Port | Destination Port | Length |
|---|---|---|---|---|---|---|---|
| 13875 | 01:30:42.401868 | 192.168.136.129 | 192.168.136.135 | TCP | 32886 | 3483 | 84 |
| 13889 | 01:30:42.504236 | 192.168.136.129 | 192.168.136.135 | TCP | 32886 | 3483 | 84 |
| 14486 | 01:31:18.165704 | 192.168.136.129 | 192.168.136.135 | TCP | 32886 | 3483 | 84 |
| 14496 | 01:31:18.258447 | 192.168.136.129 | 192.168.136.135 | TCP | 32886 | 3483 | 84 |
| 14872 | 01:31:37.624794 | 192.168.136.129 | 192.168.136.135 | TCP | 32886 | 3483 | 84 |
| 14882 | 01:31:37.717340 | 192.168.136.129 | 192.168.136.135 | TCP | 32886 | 3483 | 84 |

474. The slimserver2 log file is consistent with the network trace (modulo a slight time skew between the network stack timestamp and the application logging timestamp).

```
[vmuser@slimserver2 example]$ grep 'op IR  ' slimserver2-01.log
2022-06-22 01:17:14.0381 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:17:33.2673 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c24f4c)
2022-06-22 01:17:49.8490 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c14860)
2022-06-22 01:30:05.3874 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:05.4790 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:25.9373 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:26.0287 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:42.4033 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:42.5056 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:59.6879 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:30:59.7800 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:18.1667 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:18.2595 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:37.6259 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:37.7183 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
```

475. After packet 14872 (01:13:37.624794), SlimServer responds with a series of eight 'grfd' command packets to the player animating the new screen pushing the old screen off to the left. See, e.g.: Slim::Player::SqueezeboxG::pushLeft(), Slim/Player/SqueezeboxG.pm (v5.3.1), 401–414 at 413; Slim::Player::SqueezeboxG::pushUpdate(), Slim/Player/SqueezeboxG.pm (v5.3.1), 447–464 at 459; Slim::Player::SqueezeboxG::drawFrameBuf(), Slim/Player/SqueezeboxG.pm (v5.3.1), 368–382 at 380.

476. Each such packet begins with a two-byte length field and a four-byte command field. The 'grfd' are identified in the network trace using a WireShark display filter that selects for: source port 3483 — from SlimServer to player; TCP length > 0 — to filter out pure acknowledgement packets; command code 'grfd'; destination 192.168.136.129 (player1).

```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129
```

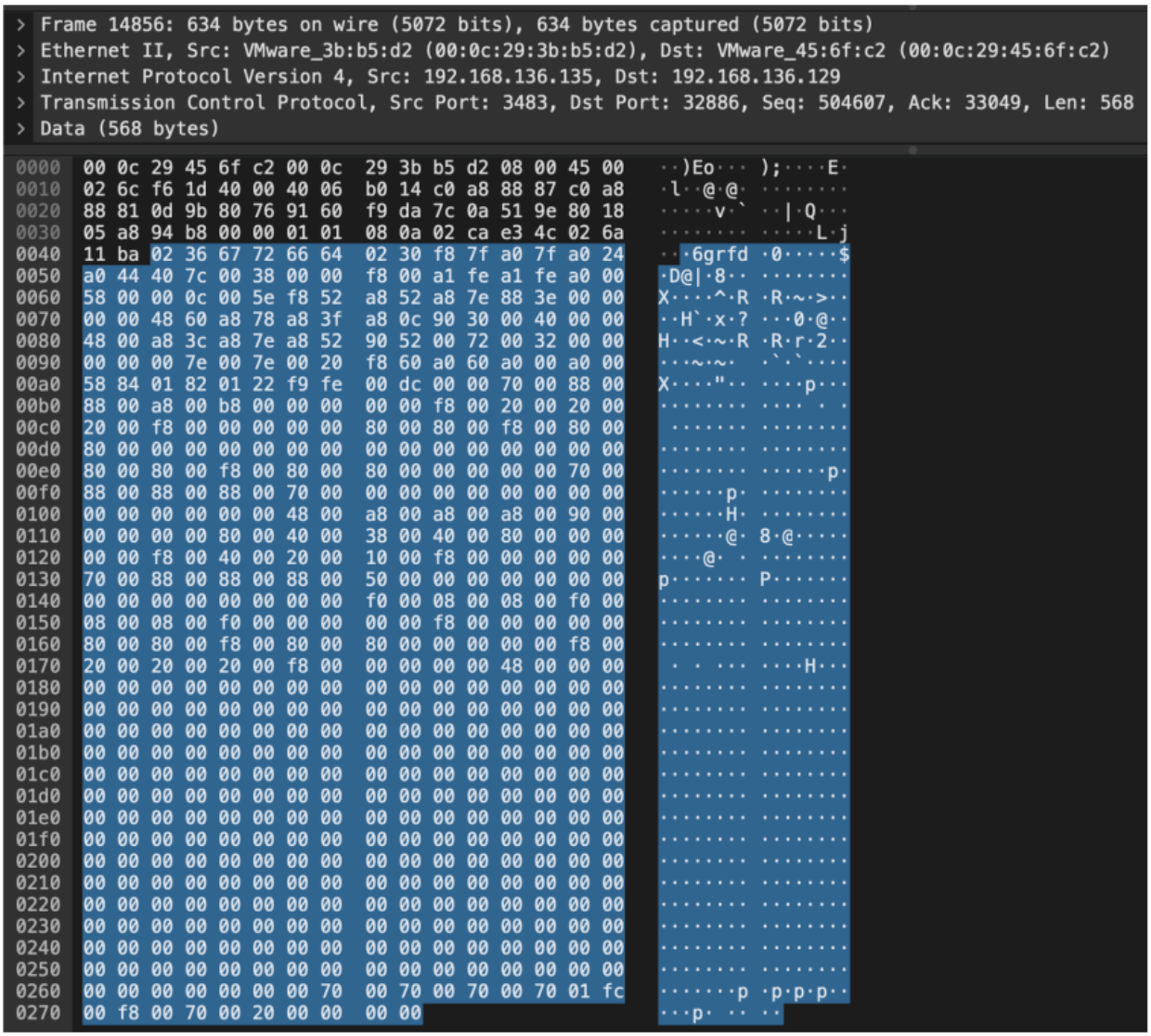
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd" && ip.dst == 192.168.136.129

Interface | Device: All advertising devices | Key: Legacy Passkey | Value | Adv Hop

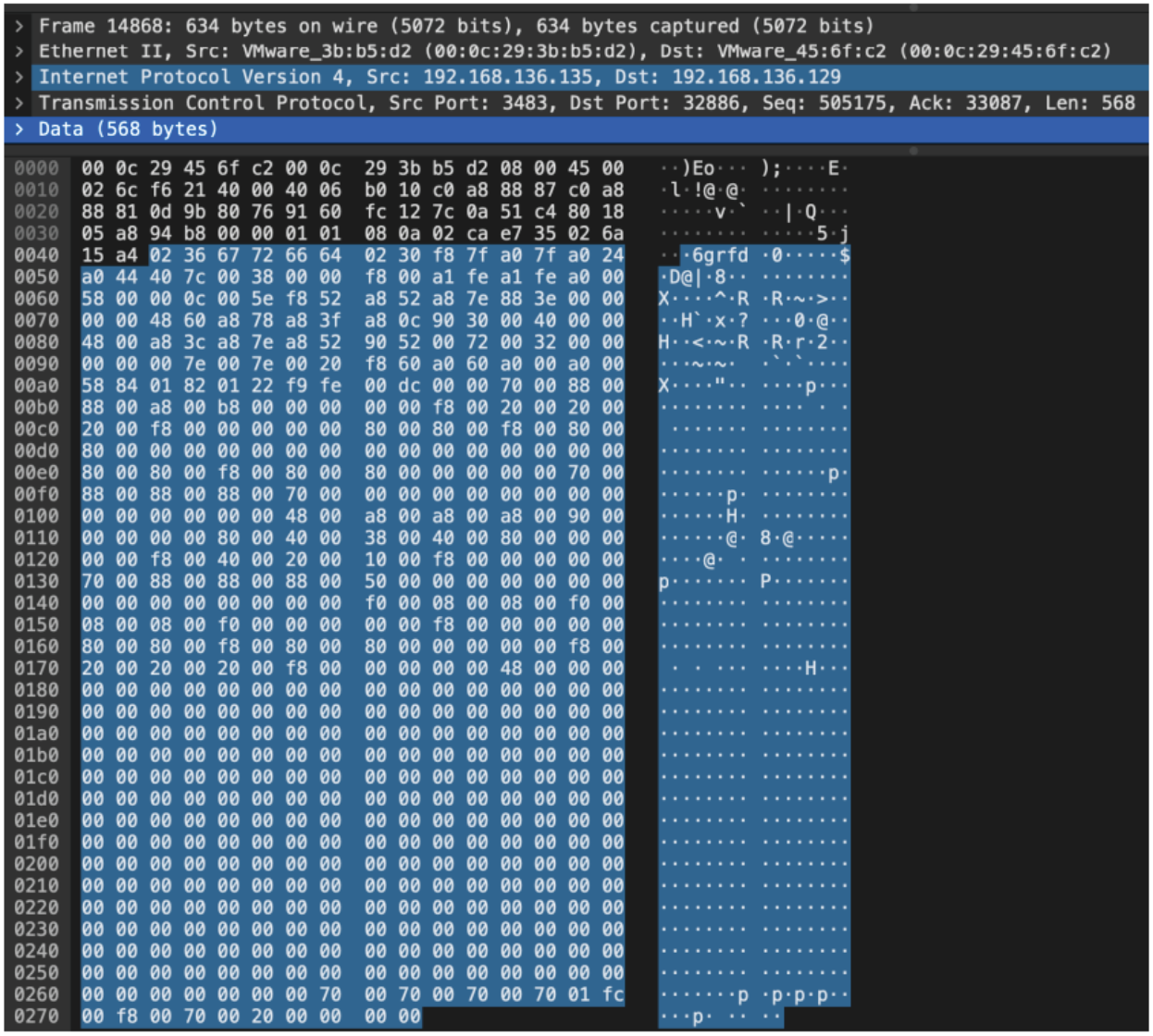
| No. | Time | Source | Destination | Protocol | Source Port | Destination Port | Length |
|---|---|---|---|---|---|---|---|
| 14796 | 01:31:31.544339 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14808 | 01:31:32.545144 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14820 | 01:31:33.545706 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14832 | 01:31:34.546145 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14844 | 01:31:35.546841 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14856 | 01:31:36.547260 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14868 | 01:31:37.547797 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14874 | 01:31:37.628768 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14876 | 01:31:37.654575 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14878 | 01:31:37.680275 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14880 | 01:31:37.706544 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14883 | 01:31:37.732211 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14885 | 01:31:37.772730 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14887 | 01:31:37.784182 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14893 | 01:31:37.810231 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14899 | 01:31:38.548328 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14911 | 01:31:39.548866 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14923 | 01:31:40.549496 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14935 | 01:31:41.549951 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 14947 | 01:31:42.550553 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |

477. The server sends a series of eight 'grfd' packets to player1 (192.168.136.129) starting at packet 14874 (01:31:37.628768) through packet 14893 (01:31:37.810231) with distinct contents, consistent with the "push left" animation. Packets 14505 (01:31:18.349026) through 14868 (01:31:37.547797) have identical 'grfd' payload, consistent with a repeated pre-sync screen:

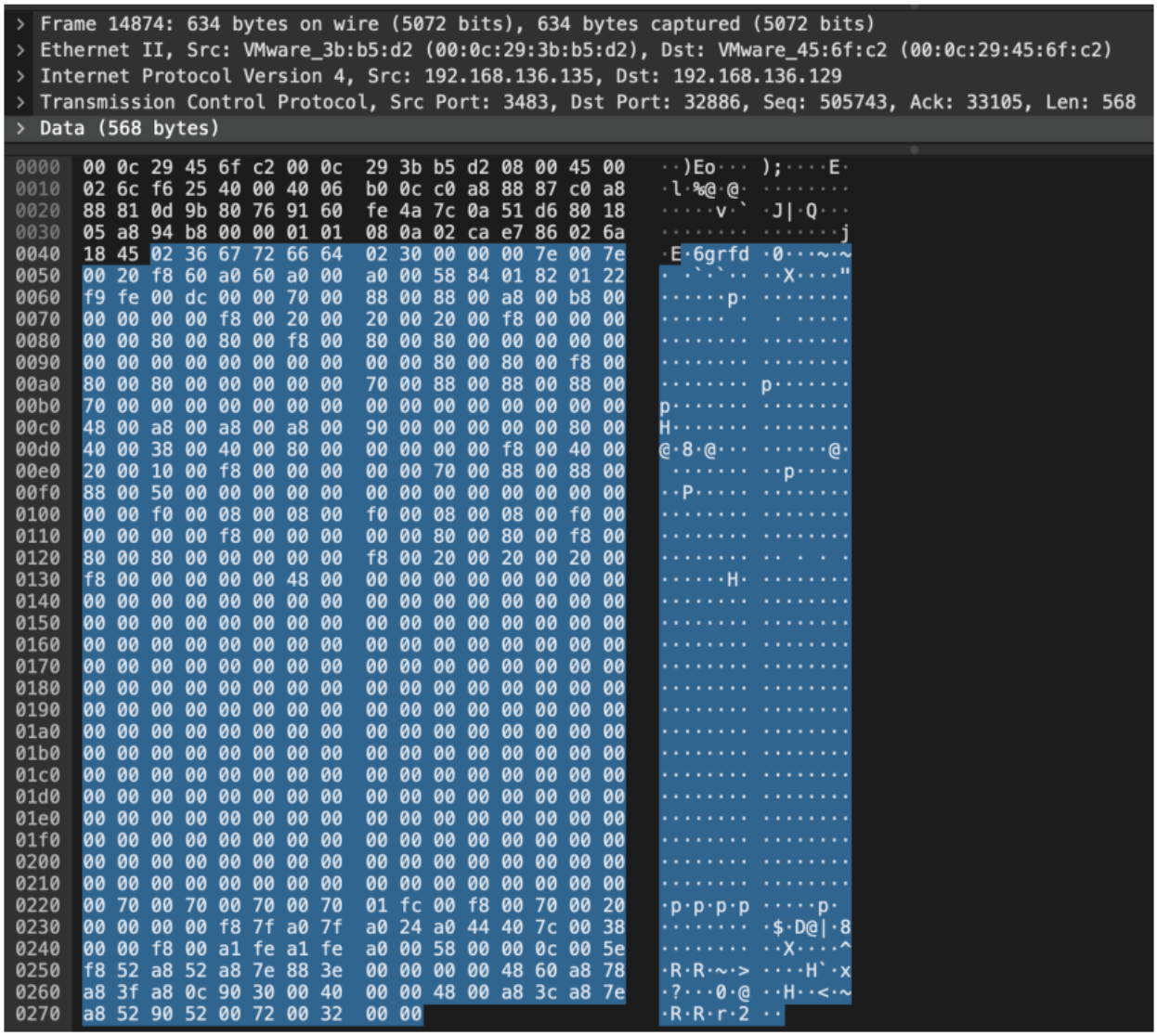
478. For example, packet 14856 (01:31:36.547260):

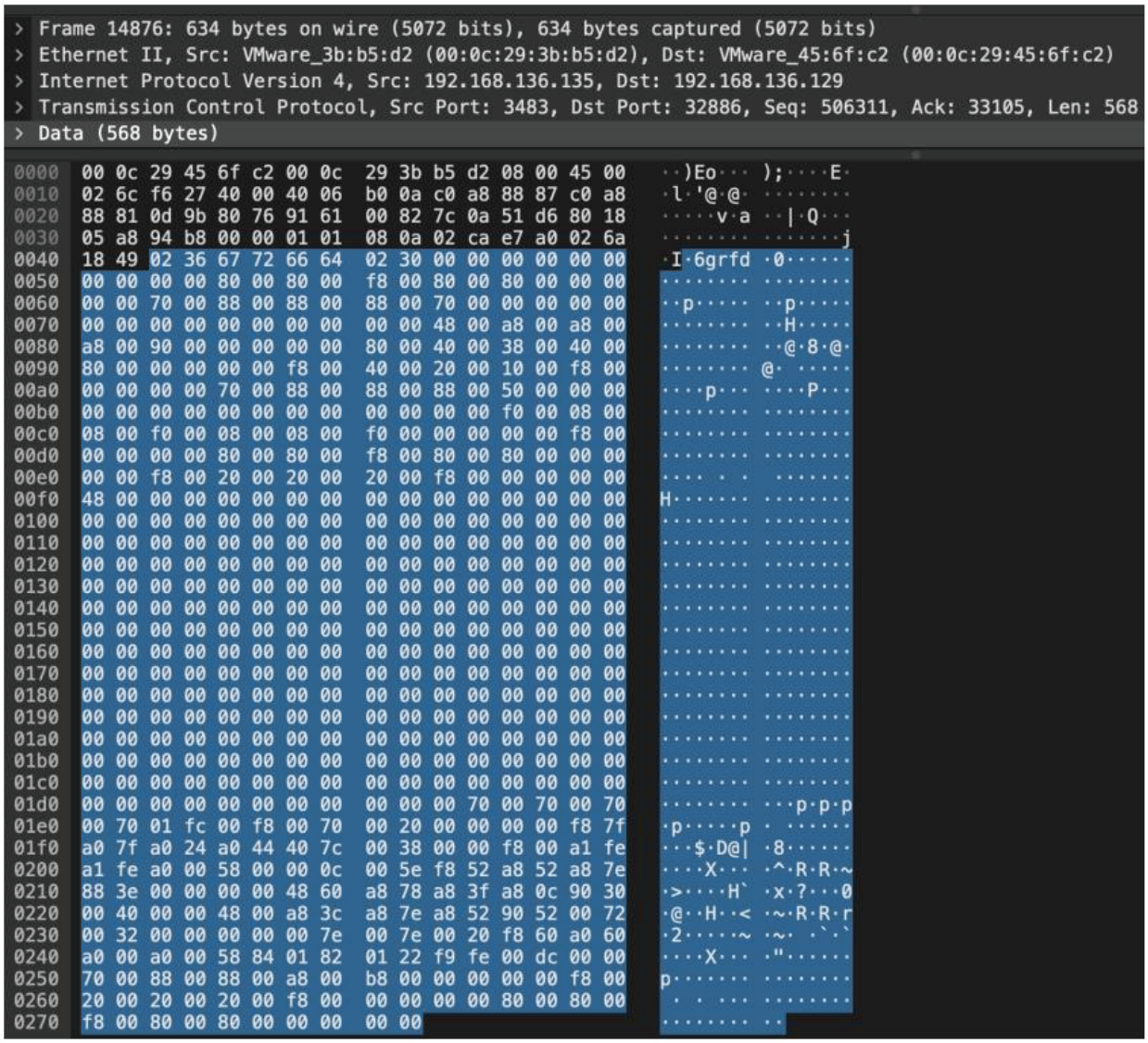


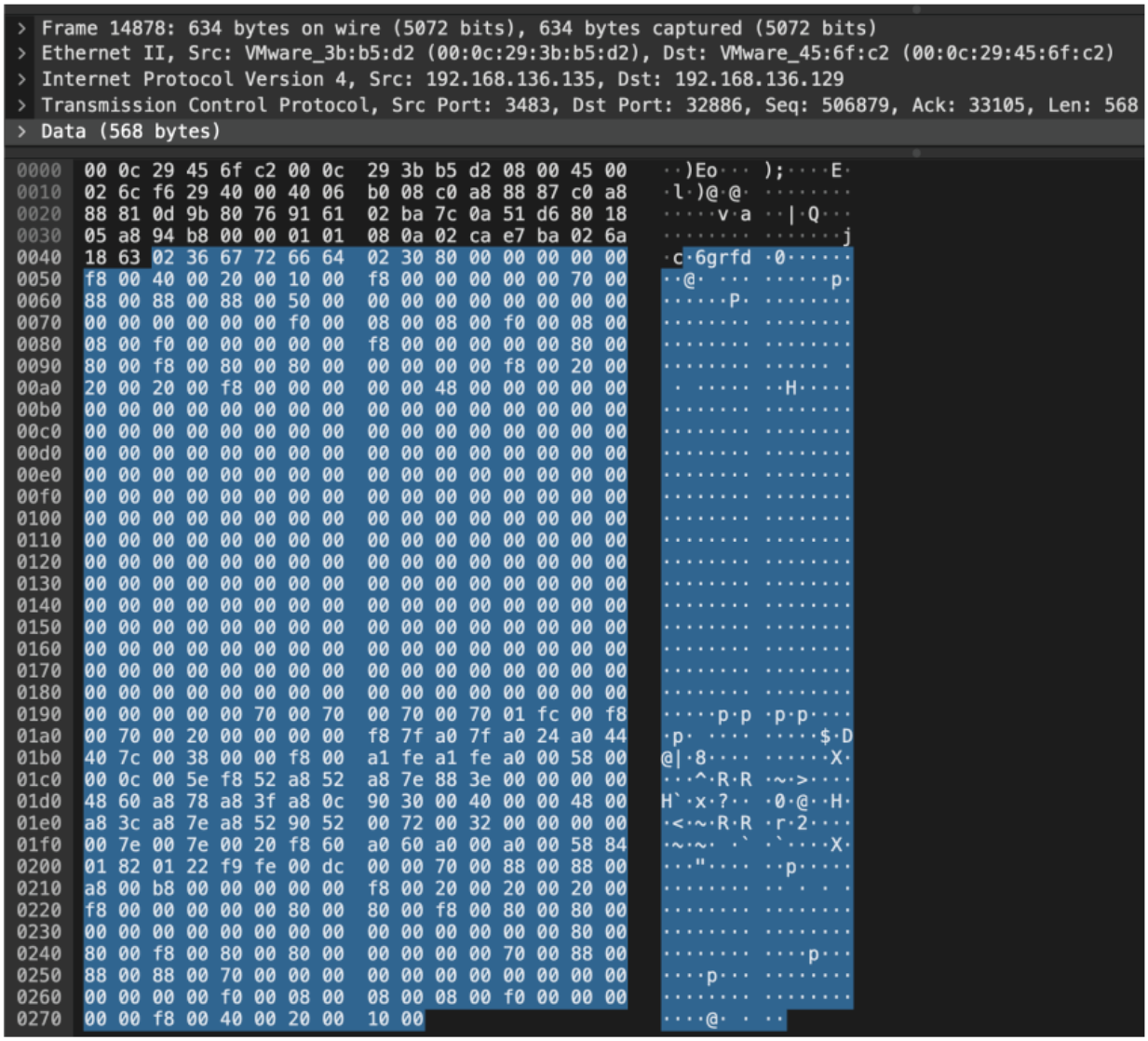

479. has the same 'grfd' payload as packet 14868 (01:31:37.547260):

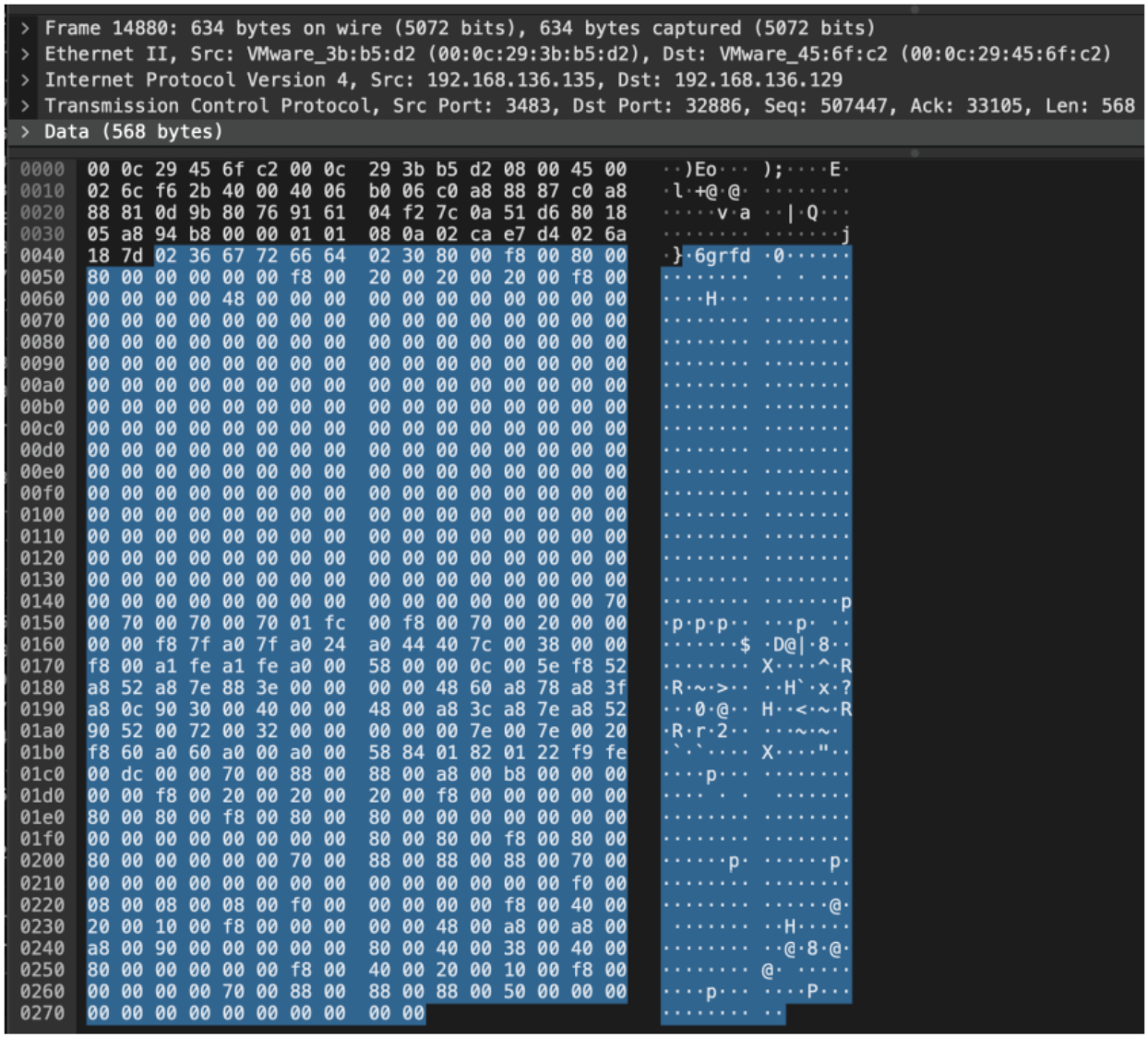



480. The payload for packets 14874 through 14893, shifting off old content and shifting in new content:

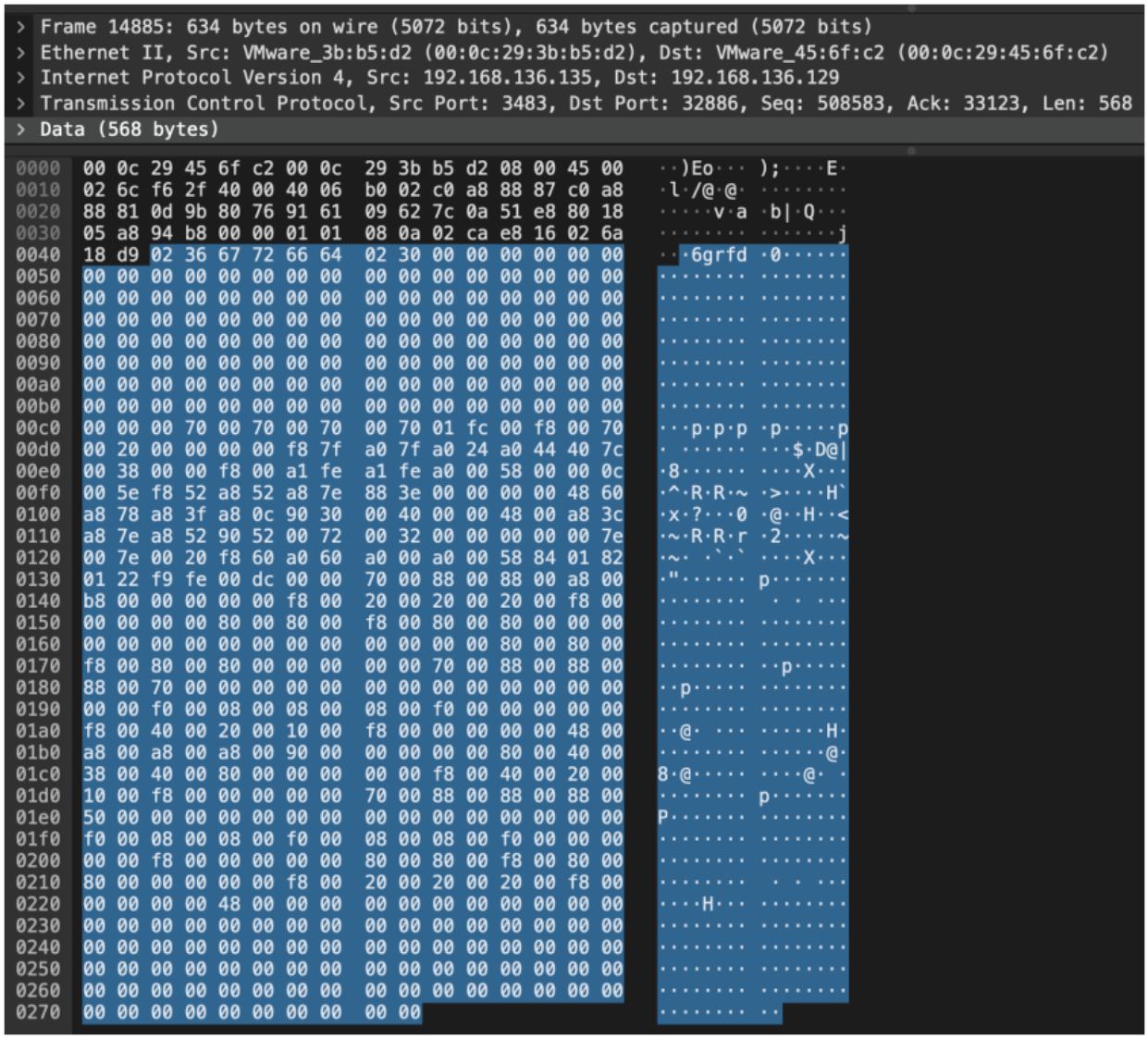

> Frame 14874: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 505743, Ack: 33105, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 25 40 00 40 06 b0 0c c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 60 fe 4a 7c 0a 51 d6 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 86 02 6a
0040 18 45 02 36 67 72 66 64 02 30 00 00 00 7e 00 7e
0050 00 20 f8 60 a0 60 a0 00 a0 00 58 84 01 82 01 22
0060 f9 fe 00 dc 00 00 70 00 88 00 88 00 a8 00 b8 00
0070 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00
0080 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 80 00 80 00 f8 00
00a0 80 00 80 00 00 00 00 00 70 00 88 00 88 00 88 00
00b0 70 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 48 00 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00
00d0 40 00 38 00 40 00 80 00 00 00 00 00 f8 00 40 00
00e0 20 00 10 00 f8 00 00 00 00 00 70 00 88 00 88 00
00f0 88 00 50 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00
0110 00 00 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00
0120 80 00 80 00 00 00 00 00 f8 00 20 00 20 00 20 00
0130 f8 00 00 00 00 00 48 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0220 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20
0230 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38
0240 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e
0250 f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78
0260 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e
0270 a8 52 90 52 00 72 00 32 00 00

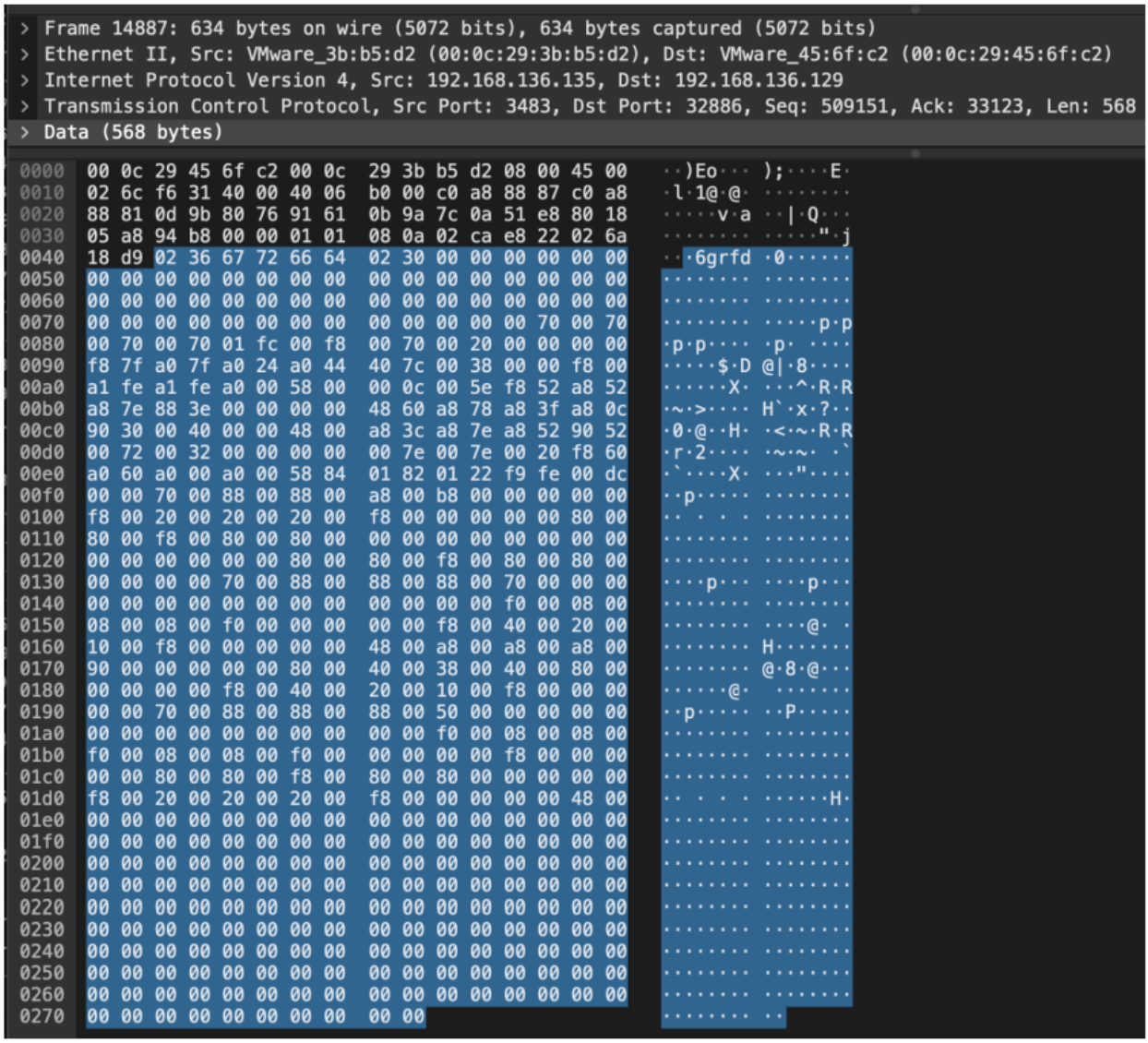

> Frame 14876: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 506311, Ack: 33105, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 27 40 00 40 06 b0 0a c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 61 00 82 7c 0a 51 d6 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 a0 02 6a
0040 18 49 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00
0060 00 00 70 00 88 00 88 00 88 00 70 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 48 00 a8 00 a8 00
0080 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00
0090 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00
00a0 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00
00c0 08 00 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00
00d0 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00
00e0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00
00f0 48 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 00 00 00 70 00 70 00 70
01e0 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f
01f0 a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe
0200 a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e
0210 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30
0220 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72
0230 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60
0240 a0 00 a0 00 58 84 01 82 01 22 f9 fe 00 dc 00 00
0250 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00
0260 20 00 20 00 20 00 f8 00 00 00 00 00 80 00 80 00
0270 f8 00 80 00 80 00 00 00 00 00

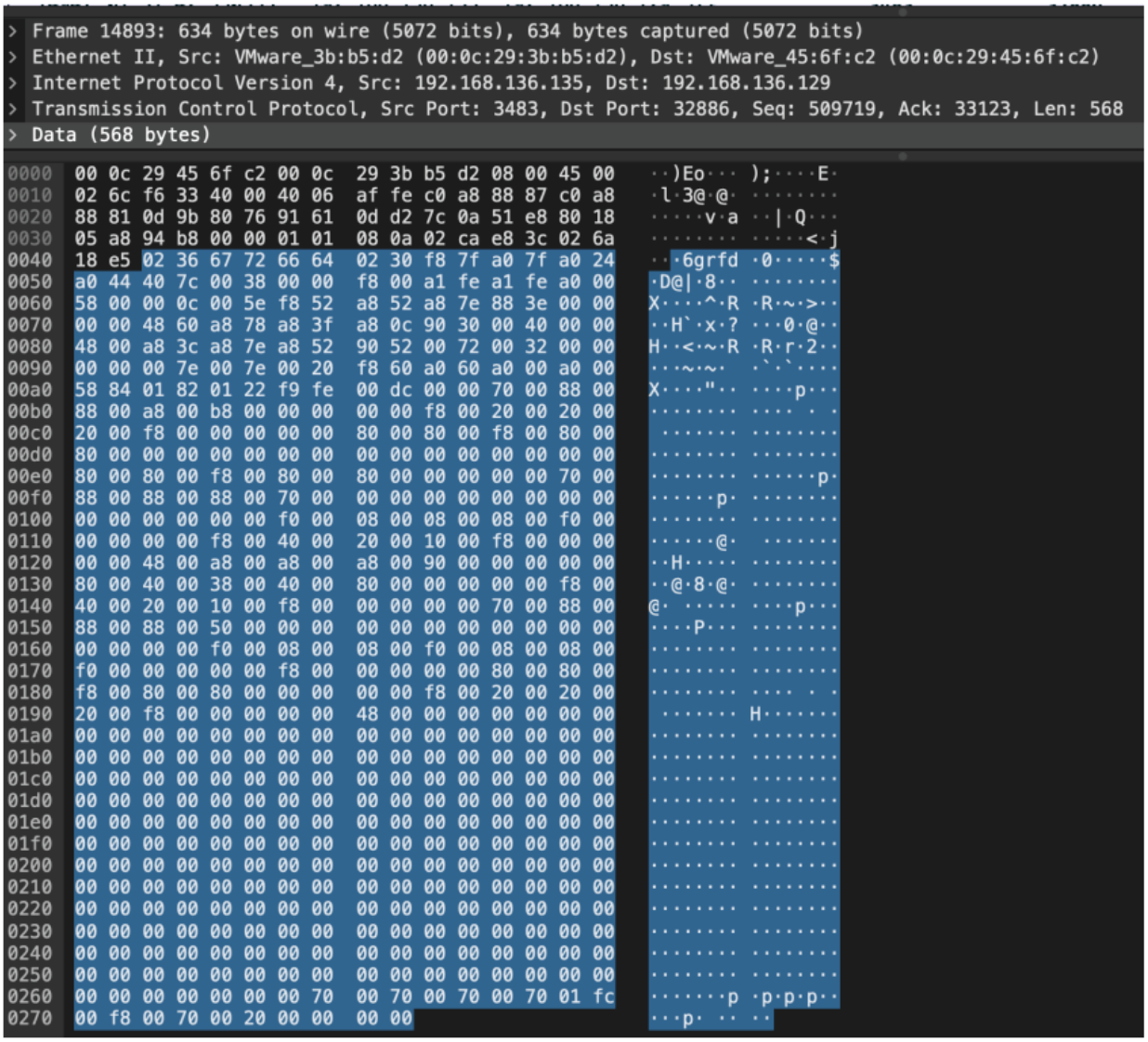

> Frame 14878: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 506879, Ack: 33105, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 29 40 00 40 06 b0 08 c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 61 02 ba 7c 0a 51 d6 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 ba 02 6a
0040 18 63 02 36 67 72 66 64 02 30 80 00 00 00 00 00
0050 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00
0060 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00
0080 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00
0090 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00
00a0 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8
01a0 00 70 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44
01b0 40 7c 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00
01c0 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00
01d0 48 60 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00
01e0 a8 3c a8 7e a8 52 90 52 00 72 00 32 00 00 00 00
01f0 00 7e 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 84
0200 01 82 01 22 f9 fe 00 dc 00 00 70 00 88 00 88 00
0210 a8 00 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00
0220 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 80 00
0240 80 00 f8 00 80 00 80 00 00 00 00 00 70 00 88 00
0250 88 00 88 00 70 00 00 00 00 00 00 00 00 00 00 00
0260 00 00 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00
0270 00 00 f8 00 40 00 20 00 10 00


> Frame 14880: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 507447, Ack: 33105, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 2b 40 00 40 06 b0 06 c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 61 04 f2 7c 0a 51 d6 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 d4 02 6a
0040 18 7d 02 36 67 72 66 64 02 30 80 00 f8 00 80 00
0050 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00
0060 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 70
0150 00 70 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00
0160 00 00 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00
0170 f8 00 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52
0180 a8 52 a8 7e 88 3e 00 00 00 00 48 60 a8 78 a8 3f
0190 a8 0c 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52
01a0 90 52 00 72 00 32 00 00 00 00 00 7e 00 7e 00 20
01b0 f8 60 a0 60 a0 00 a0 00 58 84 01 82 01 22 f9 fe
01c0 00 dc 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00
01d0 00 00 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00
01e0 80 00 80 00 f8 00 80 00 80 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 80 00 80 00 f8 00 80 00
0200 80 00 00 00 00 00 70 00 88 00 88 00 88 00 70 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 f0 00
0220 08 00 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00
0230 20 00 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00
0240 a8 00 90 00 00 00 00 00 80 00 40 00 38 00 40 00
0250 80 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00
0260 00 00 00 00 70 00 88 00 88 00 88 00 50 00 00 00
0270 00 00 00 00 00 00 00 00 00 00

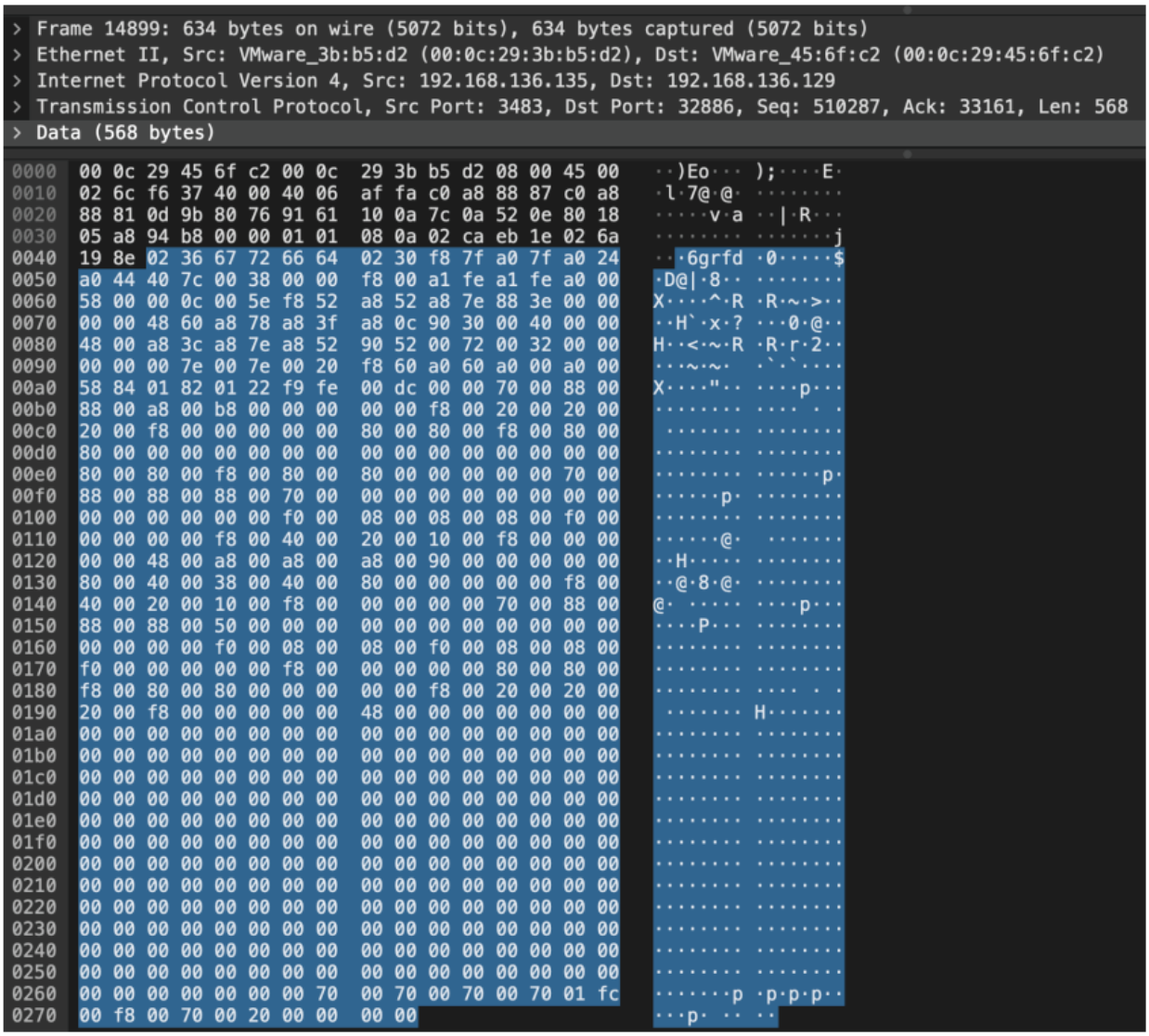
> Frame 14883: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 508015, Ack: 33123, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 2d 40 00 40 06 b0 04 c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 61 07 2a 7c 0a 51 e8 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e7 ee 02 6a
0040 18 a1 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 70 00 70 00 70 00 70
0110 01 fc 00 f8 00 70 00 20 00 00 00 00 f8 7f a0 7f
0120 a0 24 a0 44 40 7c 00 38 00 00 f8 00 a1 fe a1 fe
0130 a0 00 58 00 00 0c 00 5e f8 52 a8 52 a8 7e 88 3e
0140 00 00 00 00 48 60 a8 78 a8 3f a8 0c 90 30 00 40
0150 00 00 48 00 a8 3c a8 7e a8 52 90 52 00 72 00 32
0160 00 00 00 00 00 7e 00 7e 00 20 f8 60 a0 60 a0 00
0170 a0 00 58 84 01 82 01 22 f9 fe 00 dc 00 00 70 00
0180 88 00 88 00 a8 00 b8 00 00 00 00 00 f8 00 20 00
0190 20 00 20 00 f8 00 00 00 00 00 80 00 80 00 f8 00
01a0 80 00 80 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00
01c0 70 00 88 00 88 00 88 00 70 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 f0 00 08 00 08 00 08 00
01e0 f0 00 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00
01f0 00 00 00 00 48 00 a8 00 a8 00 a8 00 90 00 00 00
0200 00 00 80 00 40 00 38 00 40 00 80 00 00 00 00 00
0210 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 70 00
0220 88 00 88 00 88 00 50 00 00 00 00 00 00 00 00 00
0230 00 00 00 00 00 00 f0 00 08 00 08 00 f0 00 08 00
0240 08 00 f0 00 00 00 00 00 f8 00 00 00 00 00 80 00
0250 80 00 f8 00 80 00 80 00 00 00 00 00 f8 00 20 00
0260 20 00 20 00 f8 00 00 00 00 00 48 00 00 00 00 00
0270 00 00 00 00 00 00 00 00 00 00


> Frame 14885: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 508583, Ack: 33123, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 2f 40 00 40 06 b0 02 c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 61 09 62 7c 0a 51 e8 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e8 16 02 6a
0040 18 d9 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 70 00 70 00 70 00 70 01 fc 00 f8 00 70
00d0 00 20 00 00 00 00 f8 7f a0 7f a0 24 a0 44 40 7c
00e0 00 38 00 00 f8 00 a1 fe a1 fe a0 00 58 00 00 0c
00f0 00 5e f8 52 a8 52 a8 7e 88 3e 00 00 00 00 48 60
0100 a8 78 a8 3f a8 0c 90 30 00 40 00 00 48 00 a8 3c
0110 a8 7e a8 52 90 52 00 72 00 32 00 00 00 00 00 7e
0120 00 7e 00 20 f8 60 a0 60 a0 00 a0 00 58 84 01 82
0130 01 22 f9 fe 00 dc 00 00 70 00 88 00 88 00 a8 00
0140 b8 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00
0150 00 00 00 00 80 00 80 00 f8 00 80 00 80 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 80 00 80 00
0170 f8 00 80 00 80 00 00 00 00 00 70 00 88 00 88 00
0180 88 00 70 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 f0 00 08 00 08 00 08 00 f0 00 00 00 00 00
01a0 f8 00 40 00 20 00 10 00 f8 00 00 00 00 00 48 00
01b0 a8 00 a8 00 a8 00 90 00 00 00 00 00 80 00 40 00
01c0 38 00 40 00 80 00 00 00 00 00 f8 00 40 00 20 00
01d0 10 00 f8 00 00 00 00 00 70 00 88 00 88 00 88 00
01e0 50 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 f0 00 08 00 08 00 f0 00 08 00 08 00 f0 00 00 00
0200 00 00 f8 00 00 00 00 00 80 00 80 00 f8 00 80 00
0210 80 00 00 00 00 00 f8 00 20 00 20 00 20 00 f8 00
0220 00 00 00 00 48 00 00 00 00 00 00 00 00 00 00 00
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0270 00 00 00 00 00 00 00 00 00 00


> Frame 14887: 634 bytes on wire (5072 bits), 634 bytes captured (5072 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 509151, Ack: 33123, Len: 568
> Data (568 bytes)
0000 00 0c 29 45 6f c2 00 0c 29 3b b5 d2 08 00 45 00
0010 02 6c f6 31 40 00 40 06 b0 00 c0 a8 88 87 c0 a8
0020 88 81 0d 9b 80 76 91 61 0b 9a 7c 0a 51 e8 80 18
0030 05 a8 94 b8 00 00 01 01 08 0a 02 ca e8 22 02 6a
0040 18 d9 02 36 67 72 66 64 02 30 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 70 00 70
0080 00 70 00 70 01 fc 00 f8 00 70 00 20 00 00 00 00
0090 f8 7f a0 7f a0 24 a0 44 40 7c 00 38 00 00 f8 00
00a0 a1 fe a1 fe a0 00 58 00 00 0c 00 5e f8 52 a8 52
00b0 a8 7e 88 3e 00 00 00 00 48 60 a8 78 a8 3f a8 0c
00c0 90 30 00 40 00 00 48 00 a8 3c a8 7e a8 52 90 52
00d0 00 72 00 32 00 00 00 00 00 7e 00 7e 00 20 f8 60
00e0 a0 60 a0 00 a0 00 58 84 01 82 01 22 f9 fe 00 dc
00f0 00 00 70 00 88 00 88 00 a8 00 b8 00 00 00 00 00
0100 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 80 00
0110 80 00 f8 00 80 00 80 00 00 00 00 00 00 00 00 00
0120 00 00 00 00 00 00 80 00 80 00 f8 00 80 00 80 00
0130 00 00 00 00 70 00 88 00 88 00 88 00 70 00 00 00
0140 00 00 00 00 00 00 00 00 00 00 00 00 f0 00 08 00
0150 08 00 08 00 f0 00 00 00 00 00 f8 00 40 00 20 00
0160 10 00 f8 00 00 00 00 00 48 00 a8 00 a8 00 a8 00
0170 90 00 00 00 00 00 80 00 40 00 38 00 40 00 80 00
0180 00 00 00 00 f8 00 40 00 20 00 10 00 f8 00 00 00
0190 00 00 70 00 88 00 88 00 88 00 50 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 f0 00 08 00 08 00
01b0 f0 00 08 00 08 00 f0 00 00 00 00 00 f8 00 00 00
01c0 00 00 80 00 80 00 f8 00 80 00 80 00 00 00 00 00
01d0 f8 00 20 00 20 00 20 00 f8 00 00 00 00 00 48 00
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0250 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0260 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0270 00 00 00 00 00 00 00 00 00 00




481. Packets 14899 through 15094 (the last 'grfd' packet in the trace) contain the same 'grfd' payload as packet 14893. For example, packet 14899:




482. The slimserver2 log entries are consistent with the network trace. Filtering the slimserver2 shows player-to-server IR codes and server-to-player SlimProto frames:

```
grep -P 'op IR  |sending squeezebox frame' slimserver2-01.log
```

483. The filtered results show a last IR packet cluster at 01:31:37.6259 and 01:31:37.7183, representing the "right arrow" that initiates the sync. There are eight 'grfd' messages following the 01:31:37.6259 IR packet, with the eighth 'grfd' packet at 01:31:37.7886.

The timestamp for that eighth 'grfd' packet (01:31:37.7886) is consistent with the network timestamp for packet 14893 (01:31:37.810231), modulo skew between the application logging and network timestamps.

```
2022-06-22 01:31:37.3184 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.5477 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.6259 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:37.6287 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.6543 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.6801 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7062 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7183 Got Slimproto frame, op IR  , length 10, IO::Socket::INET=GLOB(0x9c33b68)
2022-06-22 01:31:37.7321 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7582 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7841 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.7886 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:37.8101 sending squeezebox frame: grfd, length: 562
2022-06-22 01:31:38.3184 sending squeezebox frame: grfd, length: 562
```

484. Consequently, packet 14893 (01:31:37.810231) represents the 'grfd' message sent from slimserver2 to player1 with the post-sync screen:

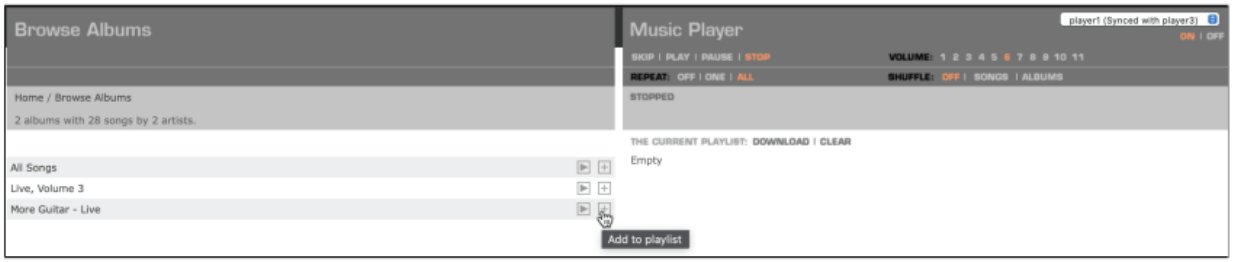
485. We can now play music on player1 through slimserver2. After synchronizing player1 with player3, player1 is on while player2 and player3 are off.

```
[vmuser@slimserver2 ~]$ grep -P 'playername|syncgroup|syncPower|power\b'
/etc/slimserver.conf
19:1e:67:04:72:30-playername = player2
19:1e:67:04:72:30-power = 0
19:1e:67:04:72:30-syncPower = 0
bc:2a:ae:6b:ab:ce-playername = player3
bc:2a:ae:6b:ab:ce-power = 0
bc:2a:ae:6b:ab:ce-syncPower = 0
bc:2a:ae:6b:ab:ce-syncgroupid = 361890235
db:3a:52:e6:70:6b-playername = player1
db:3a:52:e6:70:6b-power = 1
db:3a:52:e6:70:6b-syncPower = 0
db:3a:52:e6:70:6b-syncgroupid = 361890235
```

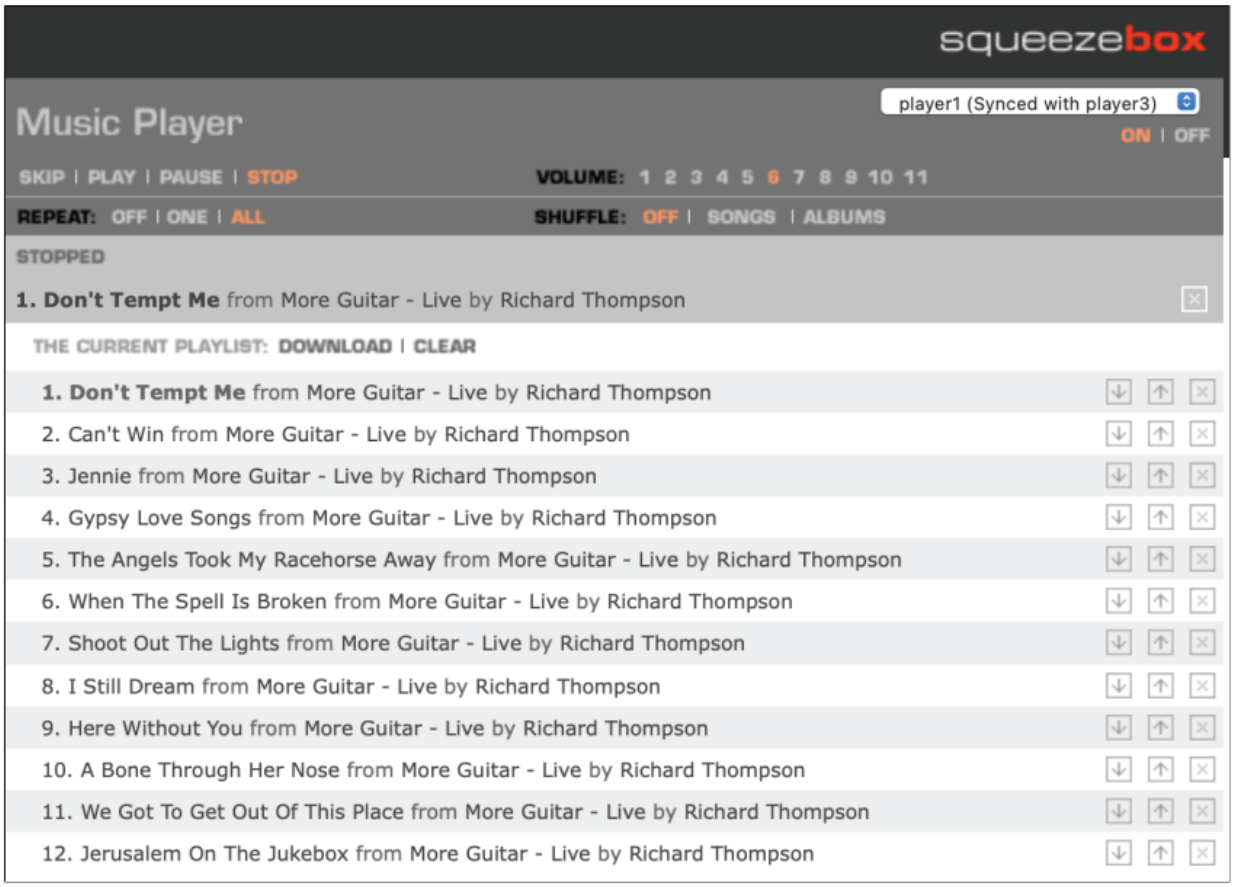
486. Start a network trace:

```
tcpdump -i eth0 -s 0 -w slimserver2-02.pcap
```

487. In the Web UI, select player1 and add an album ("More Guitar - Live") to the playlist.

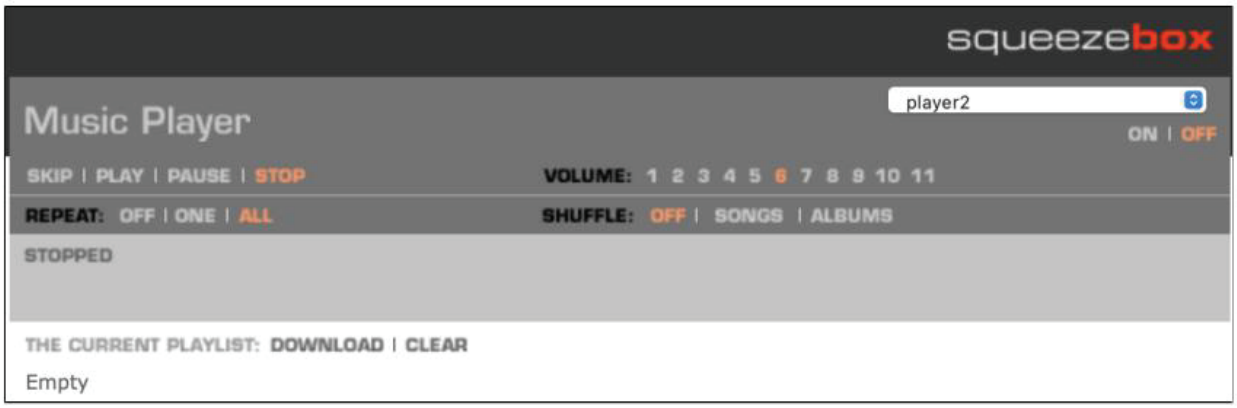



488. The album tracks are added to player1's playlist. Track 1 ("Don't Tempt Me") is the current track. Playback is stopped.



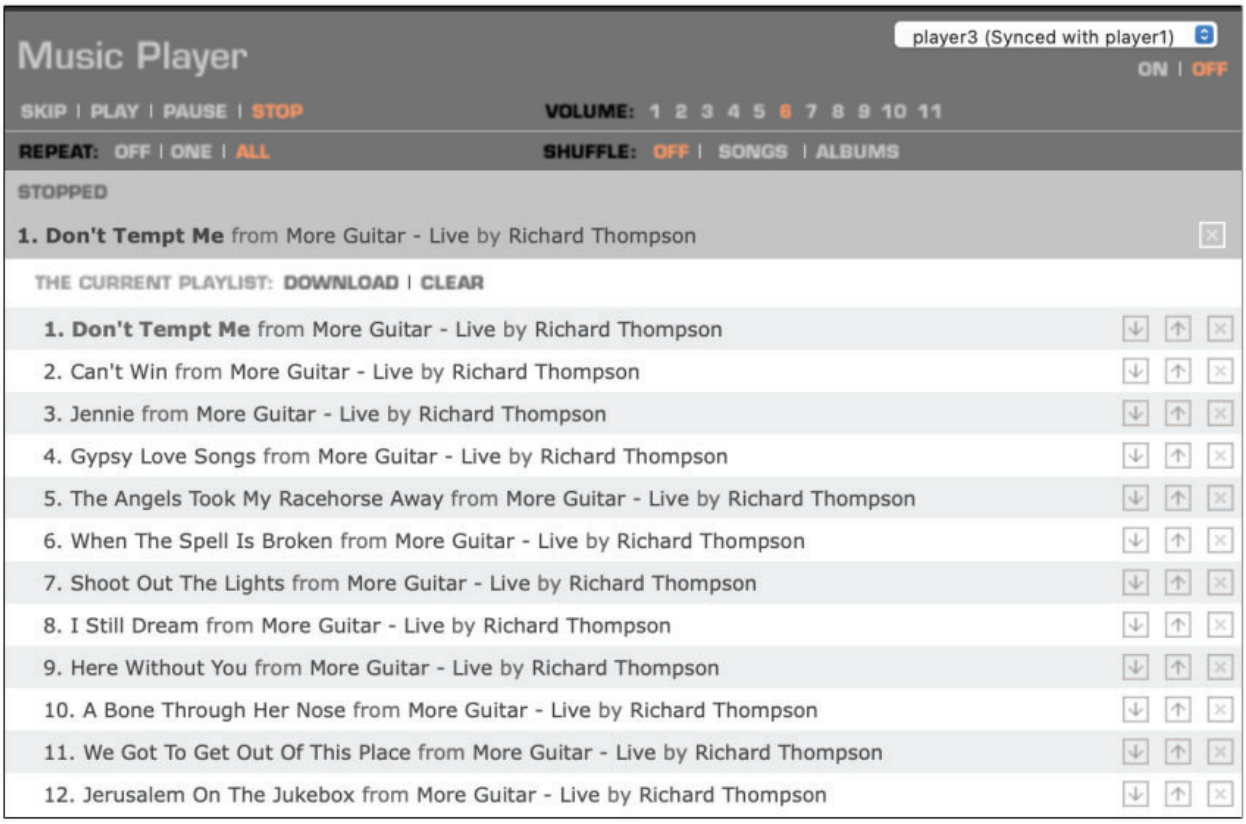

489. player1 shows "Don't Tempt Me" (1 of 12) as the current track. Playback is stopped.

490. The Web UI shows player2 as stopped, with an empty playlist.



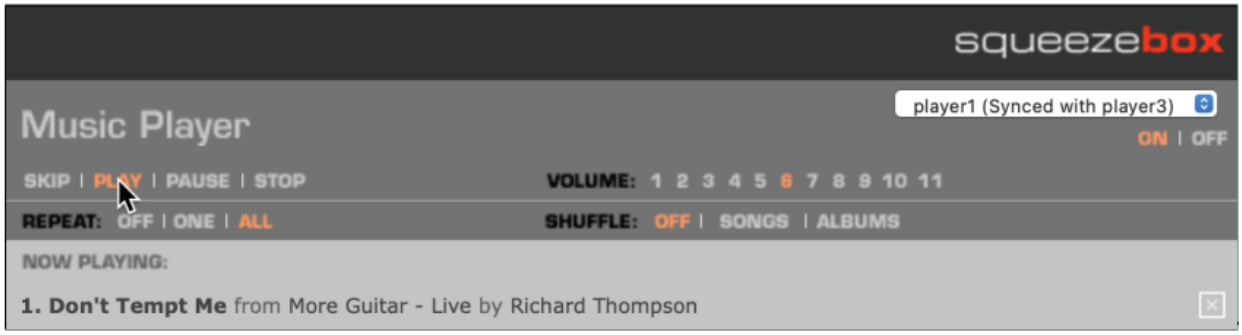

491. player2 is still powered off, in the screensaver.

492. The Web UI shows player3 as stopped with the same playlist as player1.




493. player3 is still powered off, in the screensaver.

494. In the Web UI, Select player1 and press "PLAY."

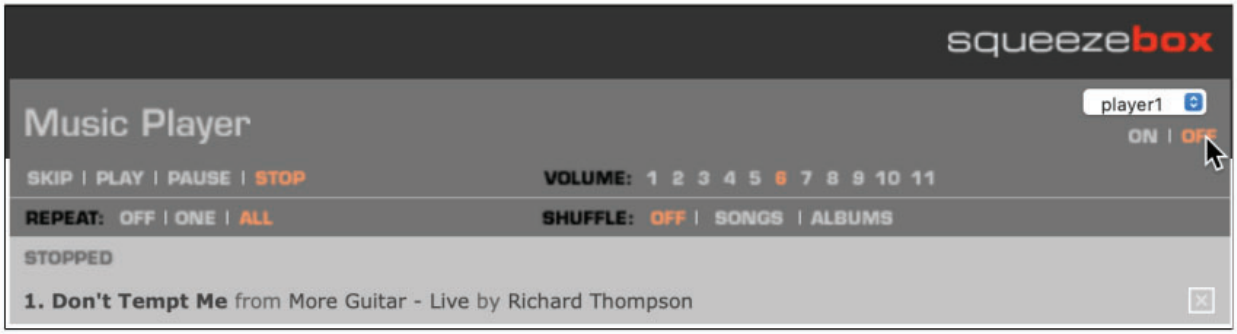


495. player1 plays "Don't Tempt Me" (1 of 12).

496. player2 is still powered off, in the screensaver.

497. player3 is still powered off, in the screensaver.

498. In the Web UI, power off player1.



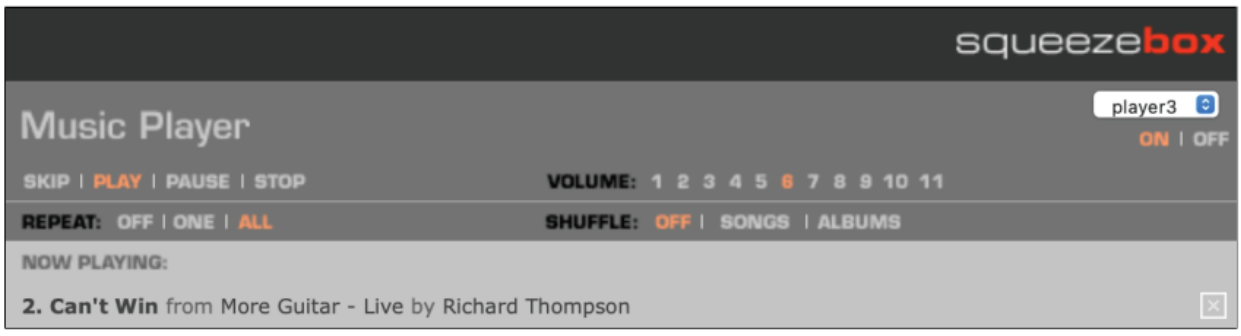

499. player1 is powered off, in the screensaver.

500. In the Web UI, power on player3.

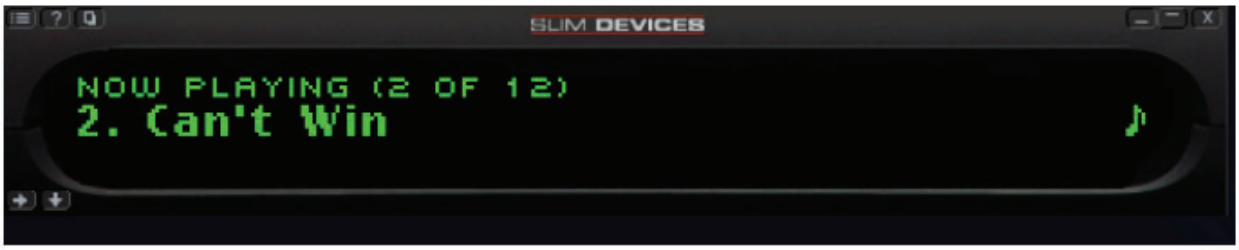
501. player3 plays "Don't Tempt Me" (1 of 12).

502. player1 is still powered off, in the screensaver.

503. Wait until track 1 finishes playing. The Web UI shows player3 as playing track 2 ("Can't Win").




504. player3 plays "Can't Win" (2 of 12).




505. player1 is still powered off, in the screensaver.

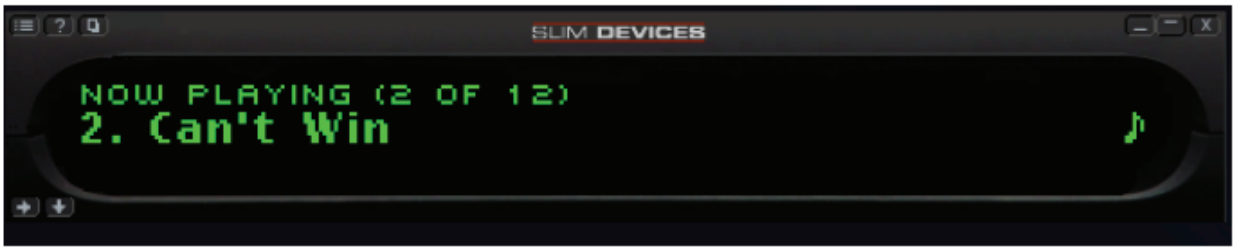
506. The Web UI shows player1 as off, stopped, and with track 1 still as the current track.

507. In the Web UI, power on player1. The Web UI shows player1 as on, playing, and with track 2 as the current track.

508. player1's screen briefly shows the home screen:

509. before transitioning to playing "Can't Win" (2 of 12).

510. player3 continues to play "Can't Win" (2 of 12).




511. At this point, in the Web UI, we can stop playback. As shown above, in the situation where (1) player3 is playing and (2) player1 is synchronized with player3 but off, then powering on player1 causes player1 to play along with player3.

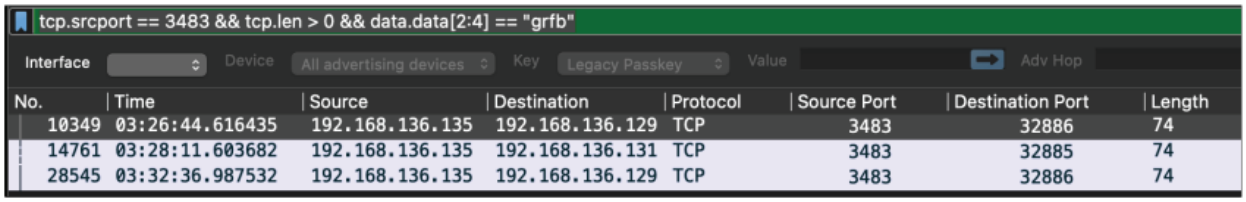
512. Analyzing the tcpdump session data using Wireshark shows when each player is powered on. As discussed above regarding powering up a player to operate with a sync group, SlimServer sends a series of SlimProto messages when powering on a player. One of the SlimProto messages is a 'grfb' command, which sets the brightness to the power-on brightness level (as opposed to the dimmed brightness when off). Similarly powering off a player sends a 'grfb' command to set the brightness to the power-off brightness level. A 'grfb' packet carries the

brightness code as the sole payload. The brightness code has five possible values (0, 1, 4, 16, 30), where 0 is the minimum and 30 is the maximum. Slim::Player::SqueezeboxG::brightness(), Slim/Player/SqueezeboxG.pm (v5.3.1), 80–91 at 88; Slim::Player::SqueezeboxG::maxBrightness(), Slim/Player/SqueezeboxG.pm (v5.3.1), 93–95; @Slim::Player::SqueezeboxG::brightnessMap, Slim/Player/SqueezeboxG.pm (v5.3.1), 78.

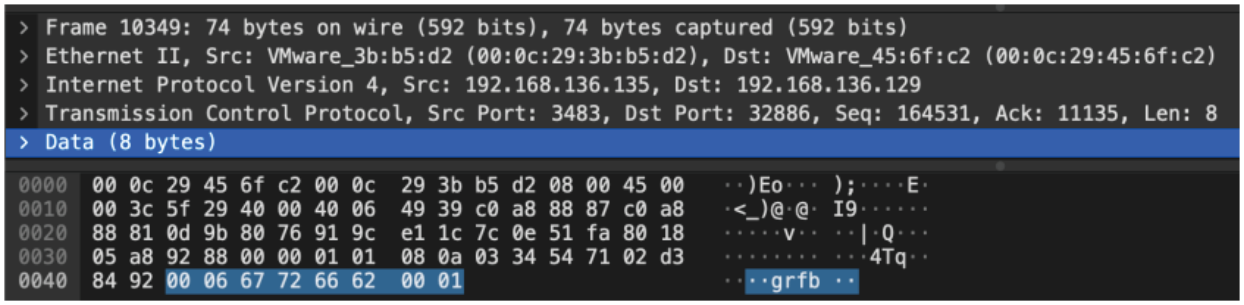
513. Identify 'grfb' packets using a WireShark display filter that selects for: source port 3483 — SlimProto from server to player; TCP len > 0 — to filter out pure ACKs; SlimProto command code "grfb".

```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfb"
```

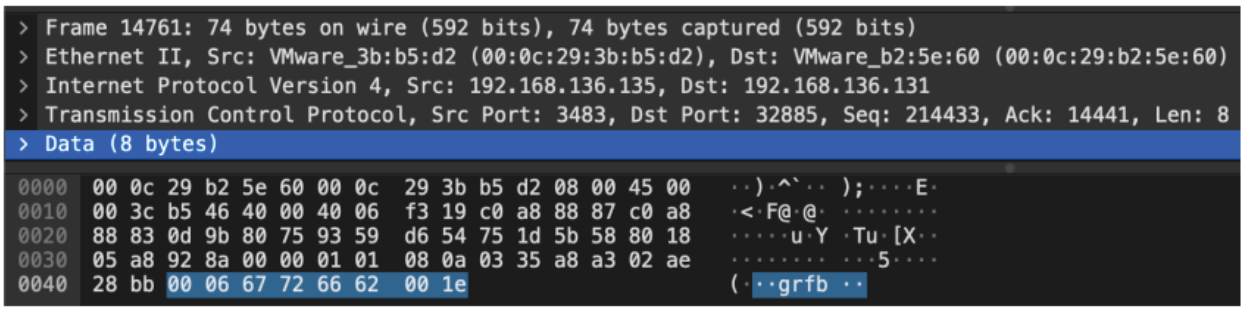
514. There are three matching packets: packet 10349 — sent to player1 (192.168.136.129); packet 14761 — sent to player3 (192.168.136.131); packet 28545 — sent to player1 (192.168.136.129).



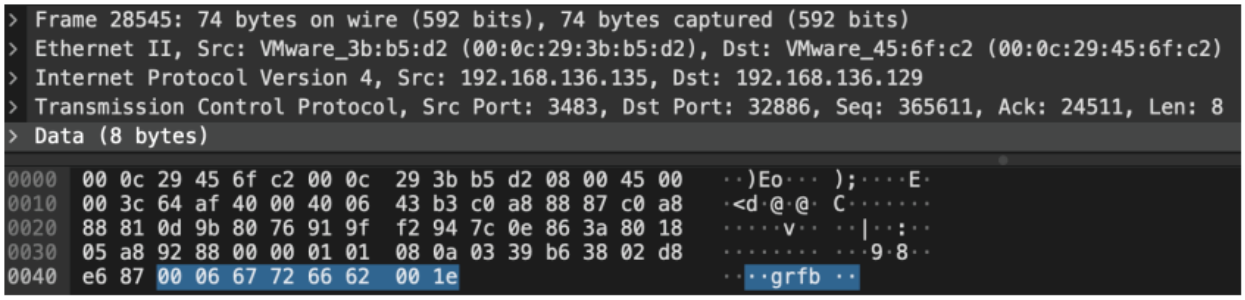

515. Packet 10349 has brightness code 0x01 (1), which is very dim and represents dimming the display when powering off player1 (192.168.136.129).



516. Packet 14761 has brightness code 0x1e (30), which is maximum brightness and represents brightening the display when powering on player3 (192.168.136.131).




517. Packet 28545 has brightness code 0x1e (30), which is maximum brightness and represents brightening the display when powering on player1 (192.168.136.129).




518. The SlimServer source code shows that, when powering on, the player sets the powerOnBrightness (ll. 224-229) and then restores the sync group (ll.230–231).

**Slim/Player/Player.pm (v5.3.1)**

```
                        if ($on) {
                                Slim::Buttons::Common::setMode($client, 'home');

                                my $welcome = ($client->linesPerScreen() == 1) ? '' : Slim::Display::Display::
center(Slim::Utils::Strings::string('WELCOME_TO_' . $client->model));
                                my $welcome2 = ($client->linesPerScreen() == 1) ? '' : Slim::Display::Display::
center(Slim::Utils::Strings::string('FREE_YOUR_MUSIC'));
                                $client->showBriefly($welcome, $welcome2);

                                # restore the saved brightness, unless its completely dark...
                                my $powerOnBrightness = Slim::Utils::Prefs::clientGet($client,
"powerOnBrightness");
                                if ($powerOnBrightness < 1) {
                                        $powerOnBrightness = 1;
                                }
                                Slim::Utils::Prefs::clientSet($client, "powerOnBrightness", $powerOnBrightness);
                                #check if there is a sync group to restore
                                Slim::Player::Sync::restoreSync($client);
```

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 217–231

519. Setting the brightness results in sending a 'grfb' command. Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 229; Slim::Utils::Prefs::clientSet(), Slim/Utils/Prefs.pm (v5.3.1), 481–489 at 488; Slim::Utils::Prefs::onChange(), Slim/Utils/Prefs.pm (v5.3.1), 312–327 at 320; $prefChange{'CLIENTPREFS'}{'powerOnBrightness}, Slim/Utils/Prefs.pm (v5.3.1), 194–199 at 197.

**Slim/Player/SqueezeboxG.pm (v5.3.1)**

```
sub brightness {
        my $client = shift;
        my $delta = shift;

        my $brightness = $client->SUPER::brightness($delta, 1);
        if (!defined($brightness)) { $brightness = $client->maxBrightness(); }
        if (defined($delta)) {
                my $brightnesscode = pack('n', $brightnessMap[$brightness]);
                $client->sendFrame('grfb', \$brightnesscode);
        }
        return $brightness;
}
```

Slim::Player::SqueezeboxG::brightness(), Slim/Player/SqueezeboxG.pm (v5.3.1), 80–91 at 88
Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm (v5.3.1), 514–533

520. After restoring the power-on brightness level, SlimServer restores the player to its sync group. When the master is in 'play' mode, SlimServer causes the client to jump to the current song in the master's playlist and transition from 'stop' mode to 'play' mode. SlimServer sends a 'strm' SlimProto command to the player to start playing the master's current song.

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 230–231
Slim::Player::Sync::restoreSync(), Slim/Player/Sync.pm (v5.3.1), 196–214 at 209
Slim::Player::Sync::sync(), Slim/Player/Sync.pm (v5.3.1), 132–167 at 159
Slim::Control::Command::execute(), Slim/Control/Command.pm (v5.3.1), 24–713 at 543
Slim::Player::Source::jumpto(), Slim/Player/Source.pm (v5.3.1), 604–640 at 614, 639
Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at
Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at 326–343, 393
Slim::Player::Squeezebox::play(), Slim/Player/Squeezebox.pm (v5.3.1), 99–107 at 104
Slim::Player::Squeezebox::stream(), Slim/Player/Squeezebox.pm (v5.3.1), 404–512 at 506

Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm (v5.3.1), 514–533

**Command: "strm"**

This takes 16 bytes data of the form:

| | | |
|---|---|---|
| $command | 1 byte | 's' start, 'p' pause, 'u' unpause, 'q' stop |
| $autostart | 1 byte | (buffer threshold to start playing at) '0' off, '1' 25%, '2' 50%, '3' 75%, '4' 100% |
| $formatbyte | 1 byte | 'p' for pcm data, 'm' for mp3 |
| $pcmsamplesize | 1 byte | '0' = 8, '1' = 16, '2' = 20, '3' = 32 usually '1' ('?' for mp3) |
| $pcmsamplerate | 1 byte | '0'=11kHz, '1'=22kHz, '2'=32kHz, '3'=44.1kHz, '4'=48kHz usually '3' ('?' for mp3) |
| $pcmchannels | 1 byte | '1'=mono, '2'=stereo usually '2' ('?' for mp3) |
| $pcmendian | 1 byte | '0' = big, '1' = little ('1' for wav, '0' for aif, '?' for mp3) |
| $prebuffer_slience | 1 byte | usually 5 (mpeg prebuffer x frames of silence) |
| $spdif_enable | 1 byte | '0'=auto, '1'=on, '2'=off usually 0 |
| | 1 byte | reserved |
| $server_port | 2 bytes | Server Port to use (9000 is the default) |
| $server_ip | 4 bytes | 0 means use IP of control server |

This is followed by an HTTP header itself. This is used to obtain the stream data eg:

GET /stream.mp3?player=$client-id HTTP/1.0
(Authorization: Basic $password)
(blank line)

The Auth line is only sent if authorization is in use. $client-id is the usually the MAC address of the player and $password is a password generated by the server.

http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html
HTML/EN/html/docs/slimproto.html

521. Consequently, when player1 powers on and rejoins an already-playing sync group, the SlimServer sends an 'strm' SlimProto message to the player to initiate playback. Isolate on SlimProto packets from SlimServer to player1 are by using a WireShark display filter that selects for: source port 3483 — from SlimServer; TCP payload length > 0 — filter out pure ACKs; destination IP is 192.168.136.129 — to player1 . . .

522. Which is expressed as:

```
tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.129
```

tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.129

Interface | Device: All advertising devices | Key: Legacy Passkey | Value | Adv Hop

| No. | Time | Source | Destination | Protocol | Source Port | Destination Port | Length |
|---|---|---|---|---|---|---|---|
| 28543 | 03:32:36.986751 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 634 |
| 28545 | 03:32:36.987532 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 74 |
| 28547 | 03:32:36.990998 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 132 |
| 28549 | 03:32:36.991542 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 148 |
| 28551 | 03:32:36.991937 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 132 |
| 28565 | 03:32:36.994092 | 192.168.136.135 | 192.168.136.129 | TCP | 3483 | 32886 | 132 |

523. As discussed above, slimserver1 sends a 'grfb' message in packet 28545 as part of the power-on sequence for player1 (192.168.136.129). The immediately following packets are: packet 28547 — 'i2cc'; packet 28549 — 'strm'.

```
> Frame 28547: 132 bytes on wire (1056 bits), 132 bytes captured (1056 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 365619, Ack: 24511, Len: 66
> Data (66 bytes)

0000  00 0c 29 45 6f c2 00 0c  29 3b b5 d2 08 00 45 00   ··)Eo··· );····E·
0010  00 76 64 b1 40 00 40 06  43 77 c0 a8 88 87 c0 a8   ·vd·@·@· Cw······
0020  88 81 0d 9b 80 76 91 9f  f2 9c 7c 0e 86 3a 80 18   ·····v·· ··|··:··
0030  05 a8 92 c2 00 00 01 01  08 0a 03 39 b6 3b 02 d8   ········ ···9·;··
0040  e6 88 00 40 69 32 63 63  73 3e 77 68 77 e0 77 00   ···@i2cc s>whw·w·
0050  77 00 77 01 77 03 77 54  77 00 77 02 77 00 70 00   w·w·w·wT w·w·w·p·
0060  73 3e 77 68 77 e0 77 00  77 00 77 01 77 03 77 57   s>whw·w· w·w·w·wW
0070  77 00 77 02 77 00 70 00  73 3e 77 6c 77 00 77 10   w·w·w·p· s>wlw·w·
0080  77 76 70 00                                       wvp·
```

```
> Frame 28549: 148 bytes on wire (1184 bits), 148 bytes captured (1184 bits)
> Ethernet II, Src: VMware_3b:b5:d2 (00:0c:29:3b:b5:d2), Dst: VMware_45:6f:c2 (00:0c:29:45:6f:c2)
> Internet Protocol Version 4, Src: 192.168.136.135, Dst: 192.168.136.129
> Transmission Control Protocol, Src Port: 3483, Dst Port: 32886, Seq: 365685, Ack: 24511, Len: 82
> Data (82 bytes)

0000  00 0c 29 45 6f c2 00 0c  29 3b b5 d2 08 00 45 00   ··)Eo··· );····E·
0010  00 86 64 b3 40 00 40 06  43 65 c0 a8 88 87 c0 a8   ··d·@·@· Ce······
0020  88 81 0d 9b 80 76 91 9f  f2 de 7c 0e 86 3a 80 18   ·····v·· ··|··:··
0030  05 a8 92 d2 00 00 01 01  08 0a 03 39 b6 3c 02 d8   ········ ···9·<··
0040  e6 8b 00 50 73 74 72 6d  73 30 6d 3f 3f 3f 3f 00   ···Pstrm s0m????·
0050  00 00 00 00 0d 9c 00 00  00 00 23 28 00 00 00 00   ········ ··#(····
0060  47 45 54 20 2f 73 74 72  65 61 6d 2e 6d 70 33 3f   GET /str eam.mp3?
0070  70 6c 61 79 65 72 3d 64  62 3a 33 61 3a 35 32 3a   player=d b:3a:52:
0080  65 36 3a 37 30 3a 36 62  20 48 54 54 50 2f 31 2e   e6:70:6b  HTTP/1.
0090  30 0a 0a 0a                                       0···
```

524. Consequently, packet 28549 represents the 'strm' message sent to player1 to initiate playback as part of restoring player1 to its sync group.

525. A network trace illustrates the synchronization confirmation message. A tcpdump

session was initiated on the SlimServer host before using the directional buttons on the SoftSqueeze player1 remote to navigate to the "Synchronize" menu and then to select synchronization with player2 and player3. The session was terminated after the player transitioned from the pre-sync screen.

526. to the post-sync screen:

527. We first identify the IR SlimProto packets, which send IR codes from the player to the SlimServer. The player sends an IR remote code using the SlimProto IR packet to the SlimServer for processing. An IR packet is a client-to-server message, which consists of:

Operation ("IR ") — offset 0, four bytes
Data Packet Length — offset 4, four bytes
Time — offset 8, four bytes
Format — offset 12, one byte
NoBits — offset 13, one byte
IRCode — offset 14, four bytes

**Client -> Server Communications**

A command to the server consists of three parts:

1. The 1st 4 bytes specify the operation. The following operations are supported:
   - HELO
   - IR (note the two spaces after IR)
   - RESP
   - STAT
   - BYE!
2. The 2nd part (of four bytes) is simply the length of the data packet (in Network order).
3. The 3rd part is the data itself.

**"IR "** (Note the two spaces to make it up to 4 characters.)

One of these packets is recieved for each IR code recieved by the player.

**Data Length:** Fixed at 10 bytes.

**Format:**

| | | |
|---|---|---|
| Time | 4 bytes | Time since player startup in ticks (@1Khz) |
| Format | 1 byte | Code Format (ignored by the server for now - Code represents type of IR code - NEC, JVC or Sony) |
| NoBits | 1 byte | Length of IR Code (ignored by the server for now - 16 bits for JVC, 32 bits for NEC?) |
| IRCode | 4 bytes | the IR Code itself (upto 32 bits) |

http://<SLIMSERVER_ADDR>:9000/html/docs/slimproto.html
HTML/EN/html/docs/slimproto.html

528. The "arrow_right" IR code is 7689d02f.

arrow_right, IR/Slim_Devices_Remote.ir (v5.3.1), 21

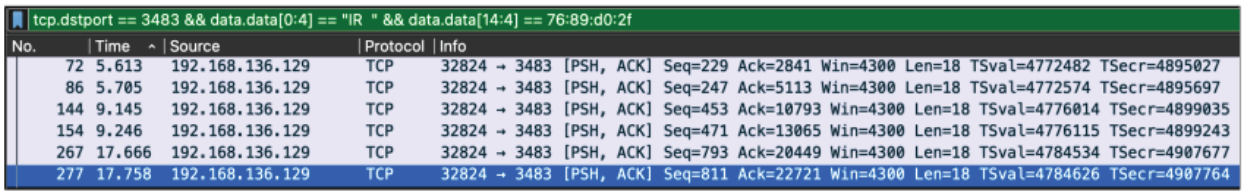
529. The IR SlimProto packets are then identified using a WireShark display filter that selects for:

destination port 3483 — from player to SlimServer
data that begins with "IR " — the IR type
data that has 0x7689d02f in the four bytes beginning at offset 14

530. which is expressed as:

```
tcp.dstport == 3483 && data.data[0:4] == "IR  " && data.data[14:4] == 76:89:d0:2f
```

531. There are six matching packets. The last packet (#277) represents the "arrow_right" IR code that initiates the sync.




532. After packet 277, SlimServer responds with a series of 'grfd' command packets to the player. Each such packet begins with a two-byte length field and a four-byte command field. The server-to-player commands are identified using a WireShark display filter that selects for:

source port 3483 — from SlimServer to player
TCP length > 0 — to filter out pure acknowledgement packets
command code 'grfd'

```
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd"
```

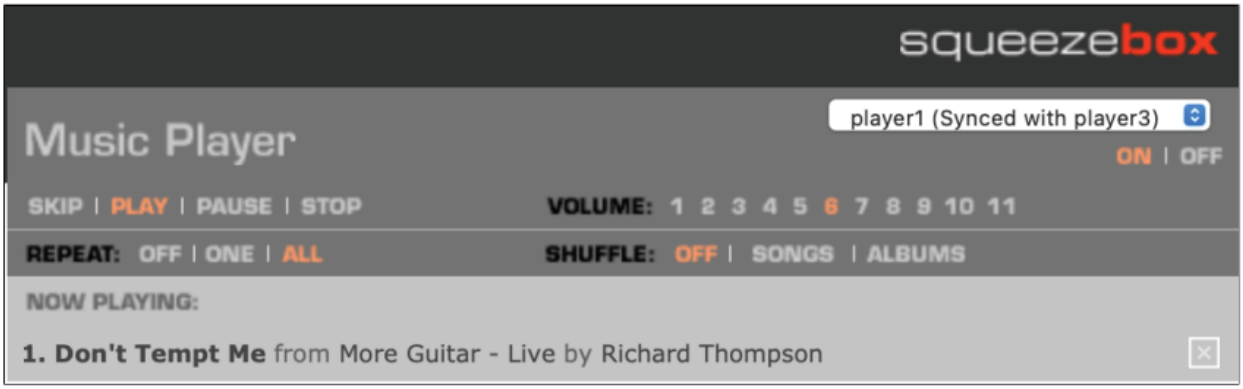
tcp.srcport == 3483 && tcp.len > 0 && data.data[2:4] == "grfd"

| No. | Time | Source | Protocol | Info |
|---|---|---|---|---|
| 278 | 17.774 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=22721 Ack=829 Win=1448 Len=568 TSval=4907790 TSecr=4784626 |
| 280 | 17.815 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=23289 Ack=829 Win=1448 Len=568 TSval=4907831 TSecr=4784683 |
| 282 | 17.826 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=23857 Ack=829 Win=1448 Len=568 TSval=4907842 TSecr=4784683 |
| 284 | 17.852 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=24425 Ack=829 Win=1448 Len=568 TSval=4907868 TSecr=4784694 |
| 292 | 18.653 | 192.168.136.128 | TCP | 3483 → 32814 [PSH, ACK] Seq=10225 Ack=723 Win=1448 Len=568 TSval=4908669 TSecr=3124568 |
| 294 | 18.657 | 192.168.136.128 | TCP | 3483 → 32813 [PSH, ACK] Seq=10225 Ack=723 Win=1448 Len=568 TSval=4908673 TSecr=3322027 |
| 296 | 18.661 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=24993 Ack=867 Win=1448 Len=568 TSval=4908677 TSecr=4784905 |
| 304 | 19.653 | 192.168.136.128 | TCP | 3483 → 32814 [PSH, ACK] Seq=10793 Ack=761 Win=1448 Len=568 TSval=4909669 TSecr=3125570 |
| 306 | 19.657 | 192.168.136.128 | TCP | 3483 → 32813 [PSH, ACK] Seq=10793 Ack=761 Win=1448 Len=568 TSval=4909673 TSecr=3323029 |
| 308 | 19.661 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=25561 Ack=905 Win=1448 Len=568 TSval=4909677 TSecr=4785907 |
| 316 | 20.654 | 192.168.136.128 | TCP | 3483 → 32814 [PSH, ACK] Seq=11361 Ack=799 Win=1448 Len=568 TSval=4910670 TSecr=3126572 |
| 318 | 20.658 | 192.168.136.128 | TCP | 3483 → 32813 [PSH, ACK] Seq=11361 Ack=799 Win=1448 Len=568 TSval=4910674 TSecr=3324031 |
| 320 | 20.662 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=26129 Ack=943 Win=1448 Len=568 TSval=4910677 TSecr=4786909 |
| 328 | 21.654 | 192.168.136.128 | TCP | 3483 → 32814 [PSH, ACK] Seq=11929 Ack=837 Win=1448 Len=568 TSval=4911670 TSecr=3127574 |
| 330 | 21.658 | 192.168.136.128 | TCP | 3483 → 32813 [PSH, ACK] Seq=11929 Ack=837 Win=1448 Len=568 TSval=4911674 TSecr=3325033 |
| 332 | 21.662 | 192.168.136.128 | TCP | 3483 → 32824 [PSH, ACK] Seq=26697 Ack=981 Win=1448 Len=568 TSval=4911678 TSecr=4787911 |

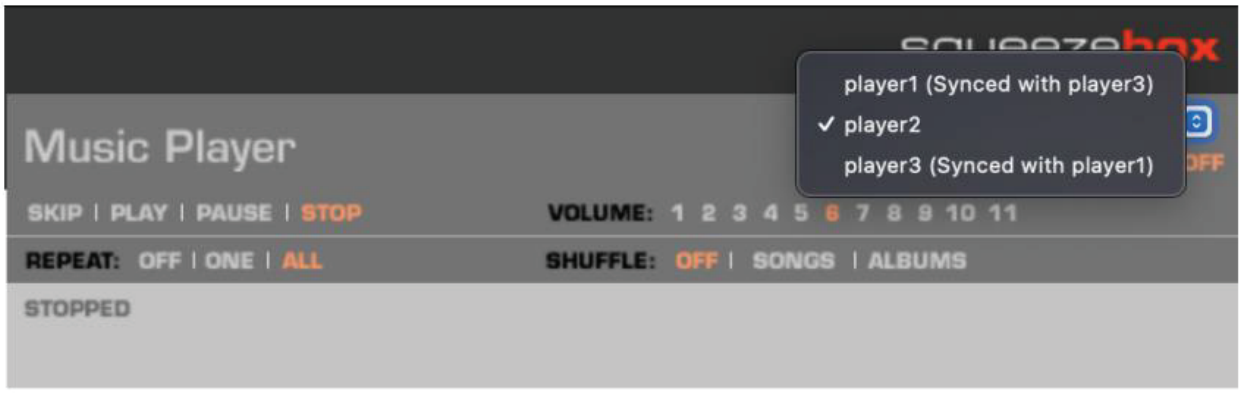
533. The network trace is also revealing for the power on sequence for a player in a sync group. For example, we begin with player1, player2, and player3 all in the same sync group, as shown by the preferences file.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

534. Leave player1 and player3 powered on. Power off player2. Play music in the sync group. player1 and player3 are actively playing music from the sync group's playlist, as shown in the Web UI.

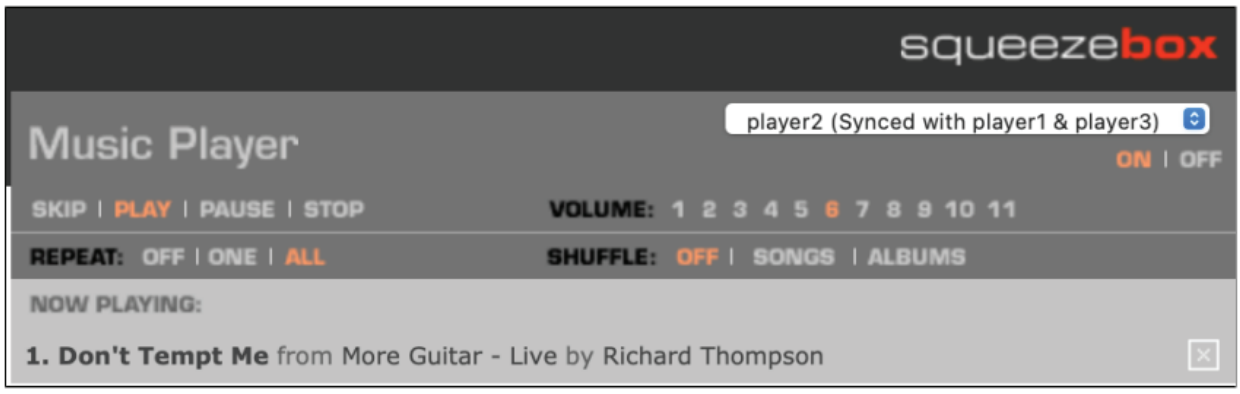



535. player2 is unsynced, stopped, and not playing any playlist.




536. player2's screen shows a dimmed screensaver with the date and time.

537. player2 synchronizes to player1 and player3, including starting playback of the same song.




538. player2's screen updates to eventually show a Now Playing screen, playing the current song in the sync group's playlist.

539. And the corresponding network trace follows. A tcpdump session was initiated on the SlimServer host before pressing the "ON" button for player2 in the Web UI. The tcpdump session was terminated after player2 finishes powering up, rejoins the sync group, and begins playing. Analyzing the tcpdump session data using Wireshark shows the power-on network traffic from SlimServer (192.168.136.128) to player2 (192.168.136.130), including idle screen updates ('grfd') every second and a poweron sequence beginning at packet 65 (time 4.948) and ending at packet 130 (time 5.004). The SlimProto packets from SlimServer to player2 are then identified using a WireShark display filter that selects for:

source port 3483 — from SlimServer
TCP payload length > 0 — filter out pure ACKs
destination IP is 192.168.136.130 — to player2

540. which is expressed as:

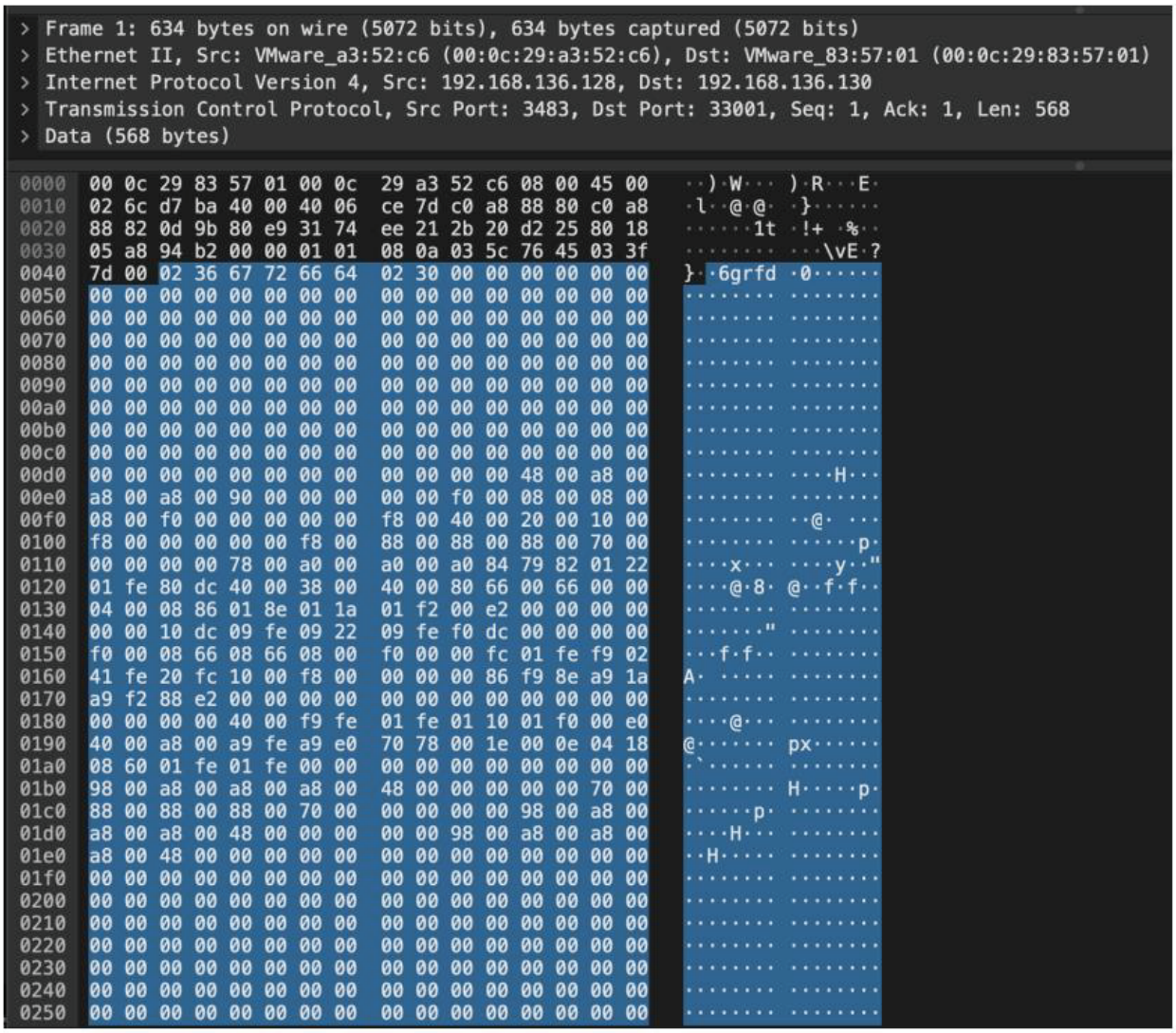
```
tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.130
```

tcp.srcport == 3483 && tcp.len > 0 && ip.dst == 192.168.136.130

| No. | Time | Source | Destination | Protocol | Info |
|---|---|---|---|---|---|
| 1 | 0.000 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=1 Ack=1 Win=1448 Len=568 TSval=56391237 TSecr=54492416 |
| 13 | 1.000 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=569 Ack=39 Win=1448 Len=568 TSval=56392238 TSecr=54493418 |
| 25 | 2.001 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=1137 Ack=77 Win=1448 Len=568 TSval=56393239 TSecr=54494420 |
| 37 | 3.001 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=1705 Ack=115 Win=1448 Len=568 TSval=56394240 TSecr=54495422 |
| 52 | 4.002 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=2273 Ack=153 Win=1448 Len=568 TSval=56395241 TSecr=54496424 |
| 65 | 4.948 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=2841 Ack=191 Win=1448 Len=568 TSval=56396187 TSecr=54497426 |
| 67 | 4.949 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=3409 Ack=191 Win=1448 Len=8 TSval=56396188 TSecr=54497475 |
| 69 | 4.956 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=3417 Ack=191 Win=1448 Len=66 TSval=56396196 TSecr=54497475 |
| 71 | 4.957 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=3483 Ack=191 Win=1448 Len=82 TSval=56396196 TSecr=54497483 |
| 73 | 4.957 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=3565 Ack=191 Win=1448 Len=66 TSval=56396196 TSecr=54497483 |
| 102 | 4.964 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=3631 Ack=191 Win=1448 Len=66 TSval=56396203 TSecr=54497484 |
| 130 | 5.004 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=3697 Ack=191 Win=1448 Len=568 TSval=56396243 TSecr=54497490 |
| 994 | 6.003 | 192.168.136.128 | 192.168.136.130 | TCP | 3483 → 33001 [PSH, ACK] Seq=4265 Ack=305 Win=1448 Len=568 TSval=56397242 TSecr=54497597 |

541. Packets 1, 13, 25, 37, and 52 contain 'grfd' SlimProto messages with very similar

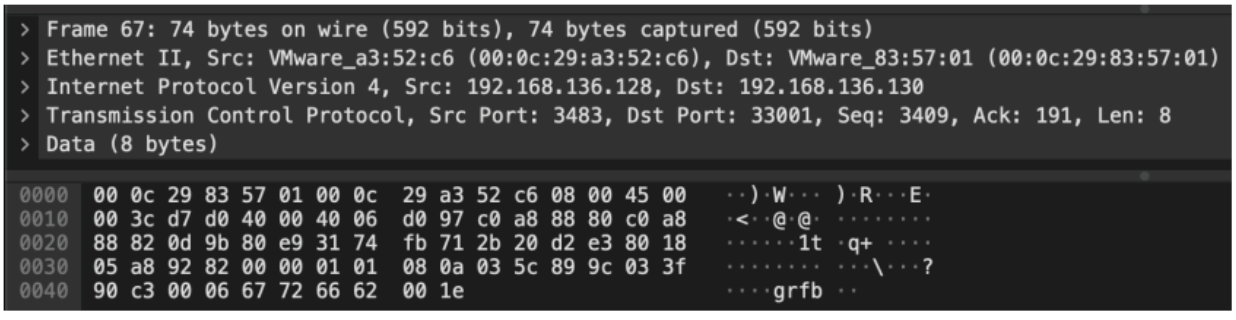
data, consistent with minor time updates in the screensaver screen. For example, packet 1 (time 0.000) contains the following data:




542. Packet 52 (time 4.002) contains similar data to packet 1:

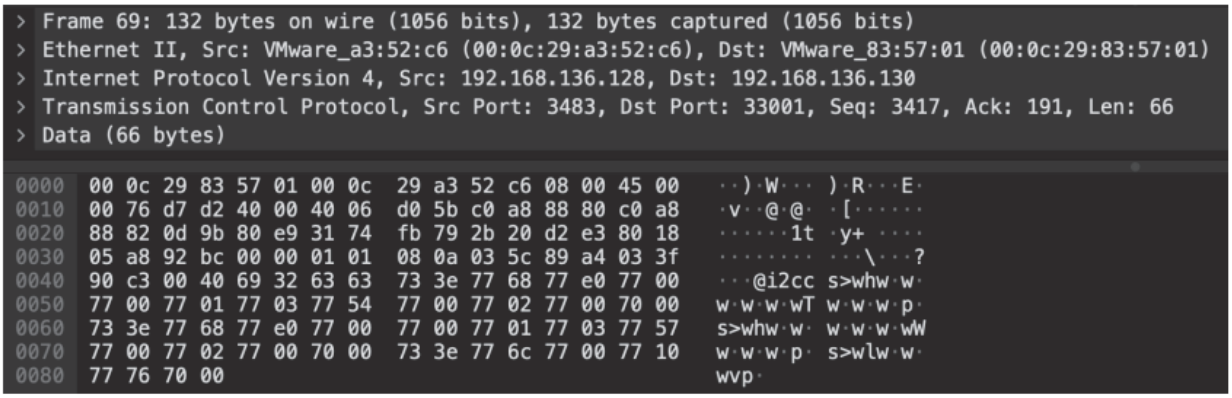
543. Packet 65 contains a 'grfd' SlimProto message with markedly different contents, which is consistent with the Welcome screen that is shown briefly on power on.

544. Packet 67 contains a 'grfb' SlimProto message, which is consistent with the message sent to restore the power-on brightness level.

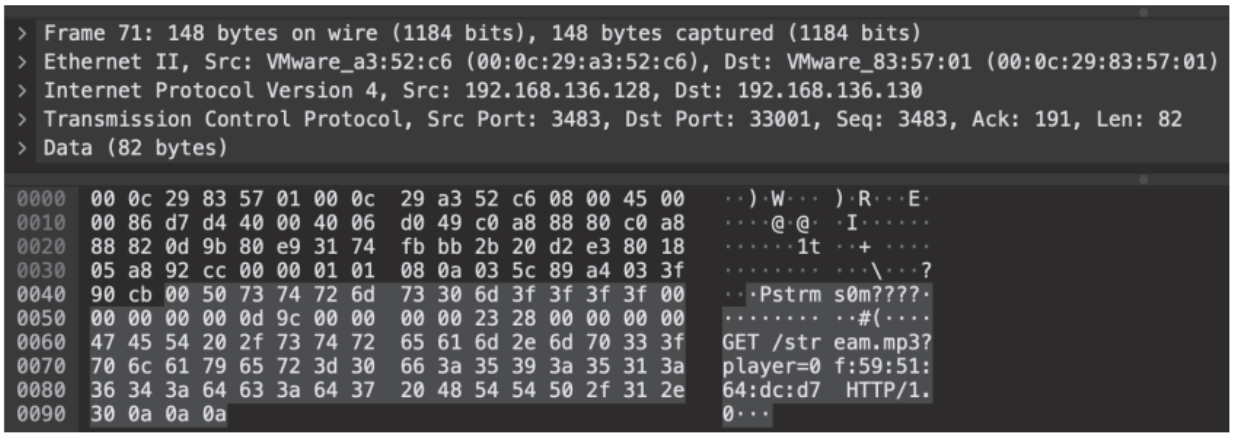



545. Packet 69 contains an 'i2cc' SlimProto message, consistent with the message sent

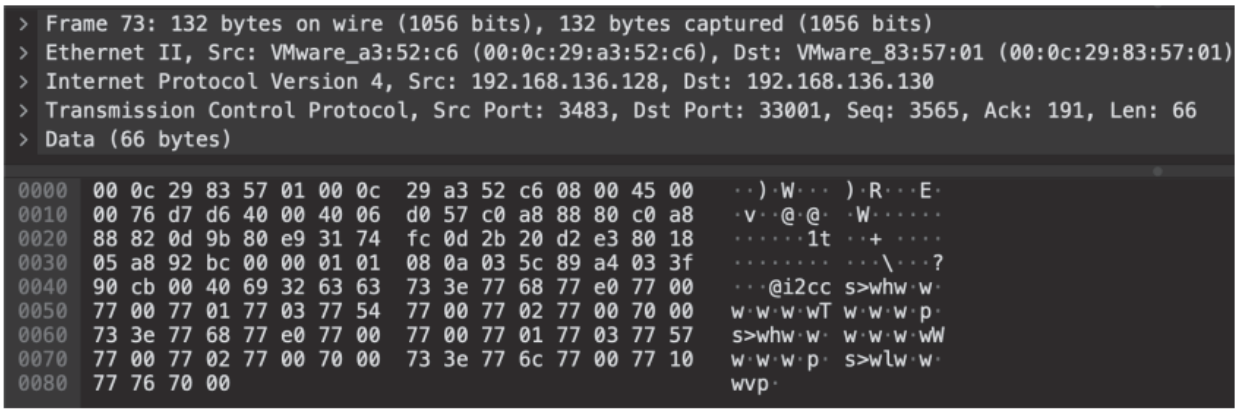
to restore volume.



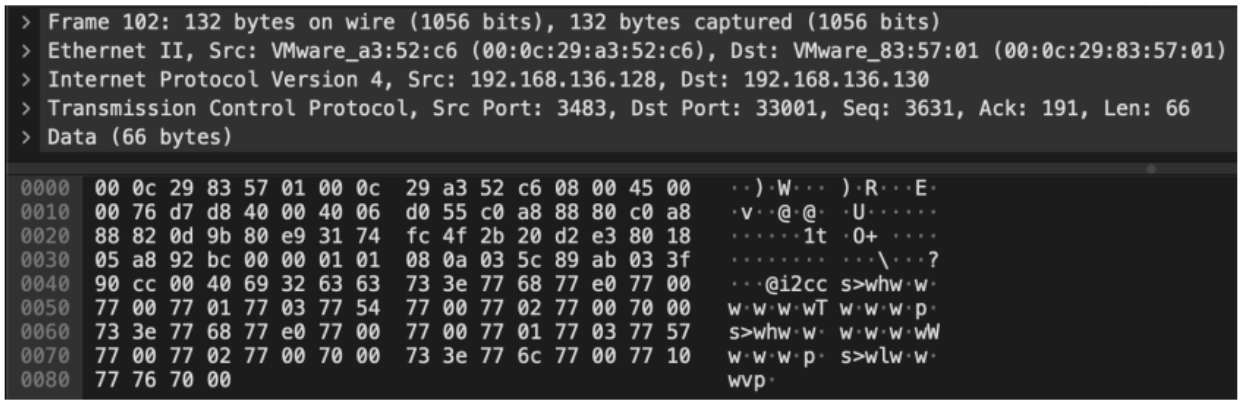

546. Packet 71 contains the 'strm' message used to tell player2 to start playing the current song in the sync group's playlist.



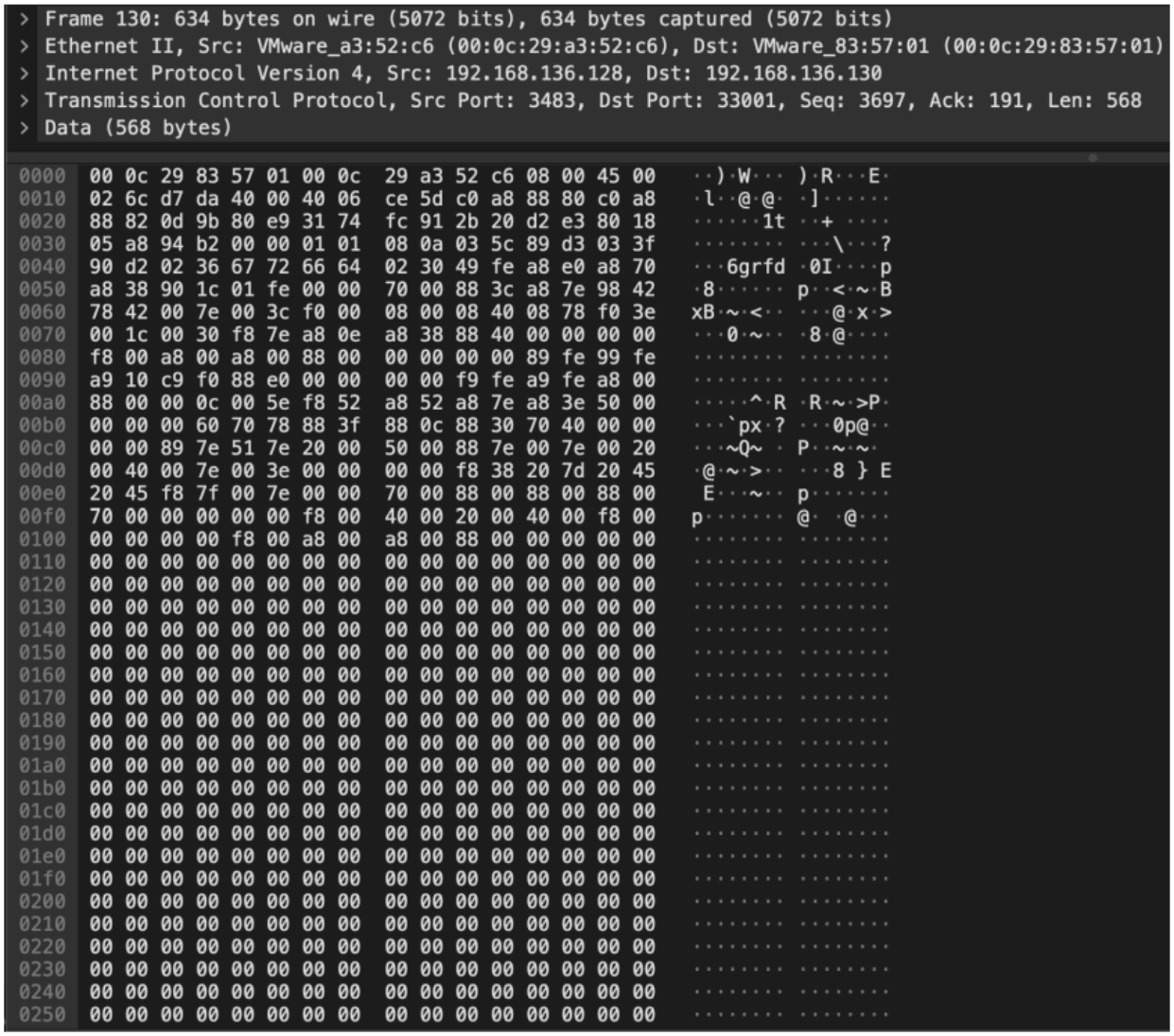

547. Packet 73 contains an 'i2cc' SlimProto message, consistent with the message sent to restore volume. The 'i2cc' payload is identical to packet 69's.




548. Packet 102 contains an 'i2cc' SlimProto message, consistent with the message sent to restore volume. The 'i2cc' payload is identical to packet 69's and packet 73's.




549. Packet 130 contains a 'grfd' SlimProto message, consistent with displaying the home screen after briefly showing the welcome screen.




550. Release information is summarized below for the testing:

| Release | Location | Notes |
|---|---|---|
| 5.3.1 | https://downloads.slimdevices.com/SlimServer_v5.3.1/ | The analyzed RPM and source code archives were originally downloaded from the Internet Archive, but the downloads were later determined to be binary-identical to the archives from downloads.slimdevices.com.<br><br>ZIP metadata shows source code dated 04-Oct-01. |
| 6.2.1 | https://downloads.slimdevices.com/SlimServer_v6.2.1/ | ZIP metadata shows source code dated 05-Nov-14. |

551. The example and the evidence cited above clearly shows that the network device

(slimserver1, slimserver2) sends an indication to the Squeezebox or Softsqueeze (e.g., player1) that it has been added to a synchronization group. That synchronization group includes one Squeezebox or Softsqueeze that is in at least one other group (e.g., player1 + player2), and both of the groups (player1 + player2 and player1 + player3) are configured to play back music synchronously when "invoked."

1) Obviousness – POSITA

552. In the alternative, this claim limitation discloses nothing more than overlapping speaker groups, which would have been obvious to a person of skill in the art at the time. Indeed, the Squeezebox already disclosed having groups and dynamic reallocation of those groups, which indicates to a person of skill in the art that overlapping group membership is desirable, consistent with Sonos's arguments in its summary judgment briefing. A person of skill in the art would have been motivated to add overlapping groups because Squeezebox's own marketing materials touted the flexibility of its system to allow users to play back media throughout their household. *Supra*.

553. A person of skill in the art would have recognized that by allowing a user to create speaker groups, those groups may either (1) allow overlapping group membership or (2) not allow overlapping group membership. Given that allowing overlapping group membership may be attractive to certain users because there was a recognized "need for dynamic control of the audio players as a group," it would have been obvious to select allowing overlapping group membership when implementing speaker groups. '885 Patent at 2:18-19.

1) Obviousness – Nourse

554. A person of skill in the art would also have been motivated to combine the Squeezebox with Nourse, which discloses a plurality of speakers, each of which has "a unique 16-bit address." Nourse, 3:57-58. "Each of the speakers also can be assigned up to four group identifiers." *Id*. at 3:58-59. The group identifier "allows specific speakers to be assigned to a group

and receive the same signal." *Id*. at 3:61-63. Thus, any speaker "can be assigned to more than one group." *Id*. at 4:5. Nourse is analogous to the '885 patent because it is in the same field of endeavor, "controlling or manipulating a plurality of multimedia players in a multi-zone system." '885 Patent, 1:32-34. For example, Nourse, like the '885 patent, explains that it is directed to "a centralized speaker system that allows multiple speakers connected to a central amplifier speaker line to be monitored and controlled from a central location via a mater/slave protocol." Nourse at Abstract. Nourse is also reasonably pertinent to the problem to be solved by the '885 patent, which is "dynamic control of the audio players as a group." For example, Nourse explains that speakers may be "addressed individually or as part of a group" by "receiving unique content specific, respectively, to the individual remote speaker address and group address" (*id*. at 2:35-39) where the group address or identifier "allows specific speakers to be assigned to a group and receive the same signal" and play back audio as a group (*id*. at 3:61-63). Nourse teaches additional means for improving the user experience by allowing a user to add a playback device to multiple groups. Nourse at 3:57-4:5. It would have been desirable to allow a user to have a particular zone player join multiple groups (*e.g.*, the kitchen and patio could be grouped for outside entertainment, and the kitchen and living room could be grouped for inside entertainment). Having a speaker join multiple groups would increase the number of customized combinations a user could configure in their home, as the Squeezebox recognizes as an important feature. Nourse is also analogous to the Squeezebox system as both relate to digital speaker systems with dynamic grouping features.

1) Obviousness – Rajapakse (US 8,239,559)

555. A person of skill in the art would have found it obvious to combine Rajapakse with Squeezebox. Rajapakse was cited by many Sonos patents regarding speaker grouping, including patents from the same family as the '885 patent, indicating that persons of skill in the art recognized that Rajapakse was highly relevant to the claimed features. For example, Mr. Lambourne in

prosecuting US 2013/0251174 disclosed Rajapakse as relevant prior art. 2014-04-17 Information Disclosure Statement. Rajapakse was also cited by the following patents—which are closely related to the '885 patent.

| | | |
|---|---|---|
| US20130251174A1 | Sonos, Inc. | Controlling and manipulating groupings in a multi-zone media system |
| US8788080B1 | Sonos, Inc. | Multi-channel pairing in a media system |
| US9226087B2 | Sonos, Inc. | Audio output balancing during synchronized playback |
| US9226073B2 | Sonos, Inc. | Audio output balancing during synchronized playback |
| US9456279B1 | Google Inc. | Automatic control and grouping of media playback devices based on user detection |
| US9671997B2 | Sonos, Inc. | Zone grouping |
| US9729115B2 | Sonos, Inc. | Intelligently increasing the sound level of player |
| US10209948B2 | Sonos, Inc. | Device grouping |
| US10306364B2 | Sonos, Inc. | Audio processing adjustments for playback devices based on determined characteristics of audio content |
| US10331399B2 | Apple Inc. | Smart audio playback when connecting to an audio output system |
| US10356526B2 | Razer (Asia-Pacific) Pte. Ltd. | Computers, methods for controlling a computer, and computer-readable media |
| US10516718B2 | Google LLC | Platform for multiple device playout |
| US11265652B2 | Sonos, Inc. | Playback device pairing |

556. Rajapakse discloses this claim limitation.

557. For example, Rajapakse discloses dynamic playback among many speakers in groups. Rajapakse, 13:40-61 ("There may be multiple streams of audio being sent to multiple media renderers 203 in multiple zones at the same time. . . As an example, a media renderer may be the front left channel when a movie is being played to a screen that is centered between it and the front right. This would be configured as default movie stream. This same media renderer may be configured also to be the back left channel when playing a default HiFi audio stream, where hi performance front media renderers are positioned elsewhere in the room.").

558. Rajapakse also discloses synchronized playback in speaker groups. Rajapakse, 11:60-65 ("The rendition of each stream by a media renderer 203 (speaker) needs to be synchronized in time. This is enabled by the distribution server 204 working with the media

renderer 203, using a stream protocol specific to the media renderers 203. This protocol includes the methods to time-synchronize rendition of the stream.").

559. Rajapakse discloses dynamic grouping and transitioning speakers among different groups. Rajapakse, 3:65-4:2 ("If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.").

560. Rajapakse discloses that each player/speaker may be a part of multiple groups. Rajapakse, 4:47-52 ("Each media renderer 203 is set up with a variety of properties including lists of acceptable zone identifications, acceptable zone manager identifications, acceptable zone 50 control point identifications, lists of acceptable stream identifications, rendition properties such as volume and role properties.").

561. Rajapakse discloses having many properties for players within a speaker group and therefore discloses "zone scenes." Rajapakse, 4:53-5:5 ("One of these properties, the 'role' of a media renderer 203, can define what stream channel the media renderer 203 will 55 play back. Each audio data stream may include multiple channels, where each channel is defined as front left, center, front right, back left, back center, back right, subwoofer, etc. The media renderer 203 can be configured to accept one of the channels in the stream. If the stream does not contain the channel the media renderer 203 is configured for, it may be configured to play an alternate channel or not play anything. In addition to the channel type roles, a media renderer's role may include other 'roles.' A media renderer's role could be to play only deep base sounds, or to play only high pitch sounds in the media. As another example, a media renderer's role may be to provide special effects, such as echoes or background sounds. As a further example, a media renderer's role may be to play pre-recorded media segments at various points of the media stream. For example, a media renderer

203 may play pre-recorded media segments on initiation by a control point or zone manager, or based on sensing various states or conditions, such as powering up the media renderer, or detecting a sensor condition.").

562. Rajapakse discloses overlapping groups or zones, and therefore overlapping speakers within those zones. Rajapakse, 5:61-67 ("A zone is a physical space that a number of media renderers belong to and within which the media renderers are physically located. Typically a zone is a listening space, a space where the audio from all the media renderers in the space can be heard. For example, all media renderers within a single auditorium will be in the same zone. Zones may overlap and may include other zones.").

563. Rajapakse discloses that speakers may be a member of more than one group. Rajapakse, 6:2-4 ("Each media renderer 203 is assigned to one or more zones. Zones are typically identified with a Zone Identifier (ZID).").

564. Rajapakse discloses dynamic zone and speaker management. Rajapakse, 6:6-41 ("The zone manager 210 dynamically gathers and aggregates information on the media renderers 203 in its vicinity and makes this information available to other services. . . . In addition to gathering media renderer information, the zone manager 210 holds information specific to a zone, manages the media renderers 203 in the zone, and may provide additional services and actions, such as media renderer reservation to other services such as control points 201. . . . The zone control point 209 is an enhanced version of a standard control point 201. The enhancements allow the zone control point 209 to interact with the zone manager 210 to quickly gather information on sets of media renderers 203 in a zone and perform actions on the zone.").

565. Rajapakse discloses zone management that is dynamic. Rajapakse, 12:51-56 ("Once a zone manager 210 registers a media renderer 203, the zone manager 210 may view and modify the media renderer's setup by interacting with a user directly or via a control point 201.

This includes modifying the media renderer's zone list, default stream list, role, and properties such as volume.").

1) Obviousness – Millington

566. A person of skill in the art would have been motivated to combine Millington with the Squeezebox because Mr. Millington worked on Sonos products that are in the same field of endeavor as the Squezebox, and therefore it would have been an obvious choice to look to for guidance about potential modifications to that system. Mr. Millington's patents also described aspects of the Sonos System or aspects related to how those systems practice group synchronization and therefore a POSITA would have looked to Millington to understand the Sonos System or its competitors, like Squeezebox. Indeed, as noted above, Sonos looked to Squeezebox when designing its own Sonos System. Millington was also assigned to Sonos and was filed in the same timeframe as the Sonos System was released.

567. Millington discloses this claim limitation.

568. Millington discloses standalone speakers and synchronous groups. Millington at 6 ("In the following, the term "synchrony group" will be used to refer to a set of one or more zone players that are to play the same audio program synchronously. Thus, in the above example, zone players 11(1) and 11(2) comprise one synchrony group, zone player 11(3) comprises a second synchrony group, zone players 11(4) and 11(5) comprise a third synchrony group, and zone player 11(6) comprises yet a fourth synchrony group. Thus, while zone players 11(1) and 11(2) are playing the same audio program, they will play the audio program synchronously."); Millington at 6-7("Similarly, while zone players 11(4) and 11(5) are playing the same audio program, they will play the audio program synchronously.").

569. Millington discloses using dynamic groups. Millington at 7 ("In the network audio system 10, the synchrony groups are not fixed. Users can enable them to be established and

modified dynamically. Continuing with the above example, a user may enable the zone player 11(1) to begin providing playback of the audio program provided thereto by audio information source 14(1)(1), and subsequently enable zone player 11(2) to join the synchrony group. Similarly, a user may enable the zone player 11(5) to begin providing playback of the audio program provided thereto by audio information source 14(5)(2), and subsequently enable zone player 11(4) to join that synchrony group. In addition, a user may enable a zone player to leave a synchrony group and possibly join another synchrony group. For example, a user may enable the zone player 11(2) to leave the synchrony group with zone player 11(1), and join the synchrony group with zone player 11(6). As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby."); Millington at 41 ("The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.").

570. Millington discloses overlapping speaker groups. Millington at 17 ("As noted above, there may be multiple synchrony groups in the network audio system 10, and further that, for example, a zone player 11(n) may operate both as a master device 21 or a slave device 22(g) in one synchrony group, and as the audio information channel device 23 providing audio and playback timing information and clock timing information for another synchrony group."); Millington at 19("Indeed, it will be appreciated that the zone player that is utilized as the audio information channel device for synchrony group 20(2) may also be a zone player that is utilized as the master device 21(1) or a slave device 22(1)(1),..., 22(K)(1) in the synchrony group 20(1).").

1) Obviousness – Lindemann

571. A person of skill in the art would have found it obvious to combine Lindemann

with the Squeezebox. Lindemann was cited by many digital speaker patents regarding speaker grouping, including patents from the same family as the '885 Patent, indicating that persons of skill in the art recognized that Lindemann was highly relevant to the claimed features. For example, US 2013/0251174 cited to Lindemann. Lindemann and the Squeezebox are both in the same field of endeavor. Lindemann Abstract ("A digital wireless loudspeaker system includes an audio transmission device for selecting and transmitting digital audio data, and wireless speakers for receiving the data and broadcasting sound. . . . Status messages are included in the transmission frames to control speaker attributes such as speaker group, enabling or disabling a sub-woofer, and volume of the loudspeaker digitally.").

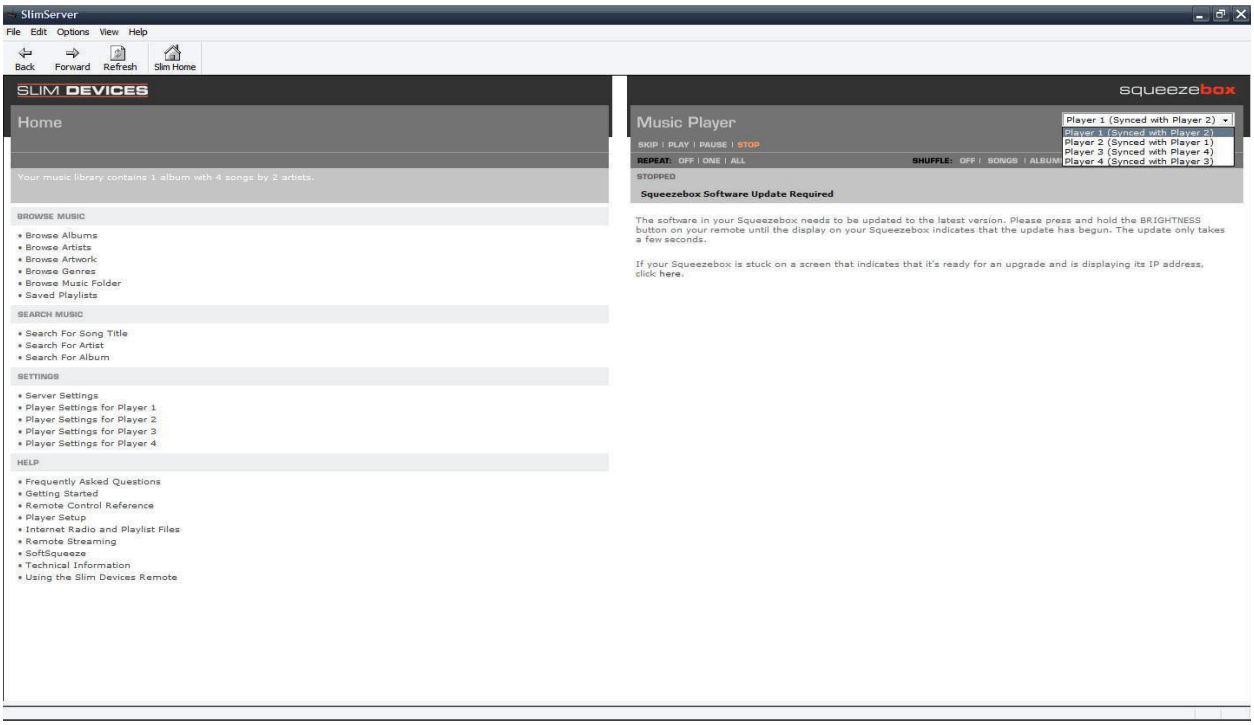
572. Lindemann discloses overlapping speaker groups. Lindemann at 0064 ("Many homes and offices have multiple groups of loudspeakers—*e.g.*, a group of loudspeakers in the living room and another group in the kitchen. The Group Selection Switch allows a loudspeaker to be assigned to one of many groups of loudspeakers.").

*(ix) Limitation 1.8: "after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation;"*

573. In my opinion, the Sonos System discloses this claim limitation.

574. Sonos argues that this claim limitation is disclosed based on arguments made in its Reply summary judgment briefing, as discussed *supra* in Section X.A. As discussed therein, Sonos argues that having a "zone scene" that is not automatically activated discloses the limitation.

575. In Squeezebox, groups may be created and saved without playing back media to those groups. Indeed, as shown in the screenshots above, a user must specifically select media for playback to the previously created groups.




576. Further, as discussed above, Sonos has taken the position that "standalone mode" includes having a zone player not playback any media. *Supra*.

577. The source code confirms that the Squeezebox meets the requirements of this claim limitation. Depending on configuration, the Squeezebox/SlimServer system can separate sync group definition from active sync group participation with respect to powered-off players. A Squeezebox player, including SoftSqueeze, can be commanded by SlimServer to power on or off. The "power off" status does not reflect the player being fully powered off (at least for SoftSqueeze). Instead, the player enters a dormant state and can be commanded to power back on. For example, a player that is powered on but in the STOP state displays an active screen (e.g., Now Playing) at normal brightness:

578. When powered off, the player displays the date and time at a dimmed brightness.

579. In the Squeezebox/SlimServer system, a player may be configured to power on/off either independently of its sync group or together with all the other players in its sync group.

http://<slimserver_addr>:9000/setup.html?page=audio&player=<PLAYER>&playerid=<PLAYER_ID>

Home / Player Settings / Audio

SETUP_SYNC_POWER_DESC, strings.txt (v5.3.1), 1518–1523

580. A powered-off player is temporarily unsynced but still defined to be part of the persistent sync group. Because a player can be configured to turn on/off independently of its sync group, a persistently defined sync group may include players that are powered off and not actively participating in a sync group. A powered-off player is "temporarily" unsynced from its sync group. See, e.g. (v5.3.1): Error rendering macro 'code': Invalid value specified for parameter 'com.atlassian.confluence.ext.code.render. InvalidValueException:

```
                        ,'syncPower' => {
                                                        'validate' =>
\&validateTrueFalse
                                                        ,'options' => {
                                                                '1' => string
('SETUP_SYNCPOWER_ON')
                                                                ,'0' =>
string('SETUP_SYNCPOWER_OFF')
                                                        }
                                                        ,'onChange' => sub {
                                                                my
($client,$changeref,$paramref,$pageref) = @_;
                                                                return if (!defined
($client));
                                                                my $value =
$changeref->{'syncPower'}{'new'};
                                                                my @buddies = Slim::
Player::Sync::syncedWith($client);
                                                                if (scalar(@buddies)
> 0) {
                                                                        foreach my
$eachclient (@buddies) {
                                                                                if
(!$value && !$eachclient->power()) {
#temporarily unsync off players if on/off set to separate
Slim::Player::Sync::unsync($client,1);
                                                                                }
Slim::Utils::Prefs::clientSet($eachclient,'syncPower',$value);
                                                                        }
                                                                }
                                                        }
                                                }
```

Slim::Web::Setup::initSetupConfig(), Slim/Web/Setup.pm (v5.3.1), 103–2118 at 951–972

**Slim/Buttons/Power.pm (v5.3.1)**

```
sub setMode {
        my $client = shift;
        $client->lines(\&lines);
        my $sync = Slim::Utils::Prefs::clientGet($client,'syncPower');
        if (defined $sync && $sync == 0) {
                $::d_sync && Slim::Utils::Misc::msg("Temporary Unsync ".$client->id()."\n");
                Slim::Player::Sync::unsync($client,1);
        }

        if (Slim::Player::Source::playmode($client) eq 'play' && Slim::Player::Playlist::song($client)) {
                if (Slim::Music::Info::isRemoteURL(Slim::Player::Playlist::song($client))) {
                        Slim::Control::Command::execute($client, ["stop"]);
                } else {
                        Slim::Control::Command::execute($client, ["pause", 1]);
                }
        }

        # switch to power off mode
        # use our last saved brightness
        $client->brightness(Slim::Utils::Prefs::clientGet($client, "powerOffBrightness"));
        $client->update();
}
```

581. When a non-master player is temporarily unsynced from its group, it is removed from the master/slave data structures in dynamic memory. The player is removed from the master's list, and the player's 'master' property is set to undefined.

**Slim/Player/Sync.pm (v5.3.1)**

```
} elsif (isSlave($client)) {
        # if we're a slave, remove us from the master's list
        my $i = 0;
        foreach my $c (@{($client->master())->slaves}) {
                if ($c->id() eq $client->id()) {
                        splice @{$client->master->slaves}, $i, 1;
                        last;
                }
                $i++;
        }

        # and copy the playlist to the now freed slave
        my $master = $client->master;
        Slim::Player::Playlist::copyPlaylist($client, $master);

        $client->master(undef);
}
```

Slim::Player::Sync::unsync(), Slim/Player/Sync.pm (v5.3.1), 62–130 at 105–121

582. However, the temporary unsync is not recorded to the preferences file. The saveSyncPrefs() method is invoked with 1 for the $temp argument, which causes its syncgroupid to be retained ("Idling Sync") rather than deleted.

**Slim/Player/Sync.pm (v5.3.1)**

```
# when we unsync, we stop, but save settings first if we're doing at temporary unsync.
if ($temp) {
        saveSyncPrefs($client,defined $temp);
        Slim::Control::Command::execute($client, ["stop"]);
} else {
        Slim::Control::Command::execute($client, ["stop"]);
        saveSyncPrefs($client,defined $temp);
}
```

Slim::Player::Sync::unsync(), Slim/Player/Sync.pm (v5.3.1), 62–130 at 122–129

**Slim/Player/Sync.pm**

```
        if ($temp) {
                $::d_sync && msg("Idling Sync for $clientID\n");
        } else {
                $client->syncgroupid(undef);
                Slim::Utils::Prefs::clientDelete($client,'syncgroupid');
                $::d_sync && msg("Clearing Sync master for $clientID\n");
        }
```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 169–194 at 187–193

583. When a player is powered on, it is restored to its sync group.

**Slim/Player/Player.pm (v5.3.1)**

```
                                #check if there is a sync group to restore
                                Slim::Player::Sync::restoreSync($client);
```

Slim::Player::Player::power(), Slim/Player/Player.pm (v5.3.1), 203–247 at 230–231

**Slim/Player/Sync.pm (v5.3.1)**

```
# Restore Sync Operation
sub restoreSync {
        my $client = shift;
        my $masterID = (Slim::Utils::Prefs::clientGet($client,'syncgroupid'));
        if ($masterID && $client->power()) {
                my @players = Slim::Player::Client::clients();
                foreach my $other (@players) {
                        next if ($other eq $client);
                        next if (!$other->power());
                        my $othermasterID = Slim::Utils::Prefs::clientGet($other,'syncgroupid');
                        if ($othermasterID && ($othermasterID eq $masterID)) {
                                $client->syncgroupid($masterID);
                                $other->syncgroupid($masterID);
                                sync($client, $other);
                                last;
                        }
                }
        }
}
```

Slim::Player::Sync::saveSyncPrefs(), Slim/Player/Sync.pm (v5.3.1), 196–214

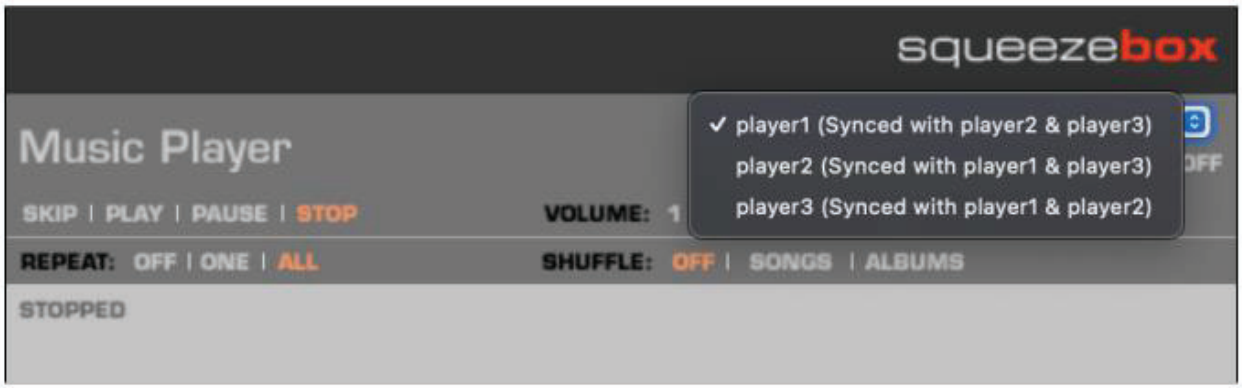
584. Examples of independently powering on/off non-master players in a sync group are described below. Consider the following set of three SoftSqueeze players, where player1, player2, and player3 are all synchronized together and player 1 is the master.

| Name | MAC (client ID) | IP | syncgroupid |
|---|---|---|---|
| player1 | bc:39:f3:c4:1e:29 | 192.168.136.129 | 482986368 |
| player2 | 0f:59:51:64:dc:d7 | 192.168.136.130 | 482986368 |
| player3 | 51:93:a5:ad:53:20 | 192.168.136.131 | 482986368 |

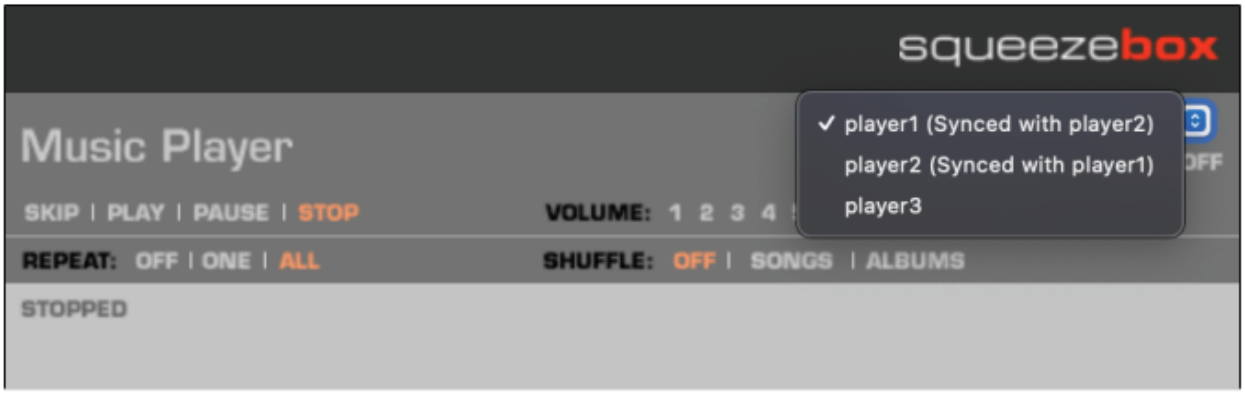
585. The preferences file (slimserver.conf) shows all players in the same sync group (482986368), as shown by the following 'grep' search of the preferences file.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

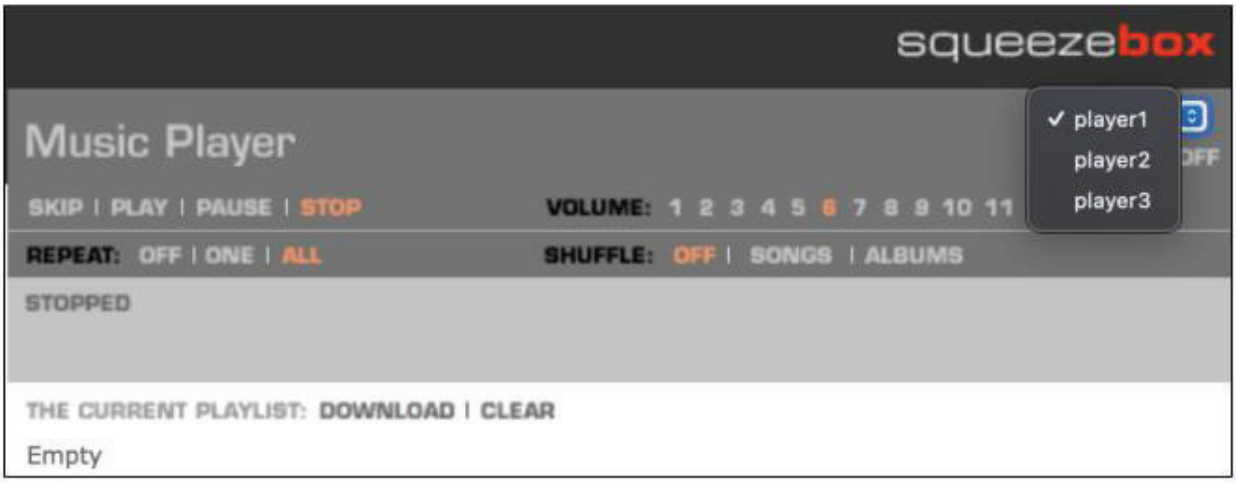
586. When all three players are powered on, the Web UI shows player1 synchronized with player2 and player3.




587. After pressing the "OFF" button in the Web UI's Music Player pane to power off player3, the Web UI shows player1 and player2 still synced, but player3 is unsynced.



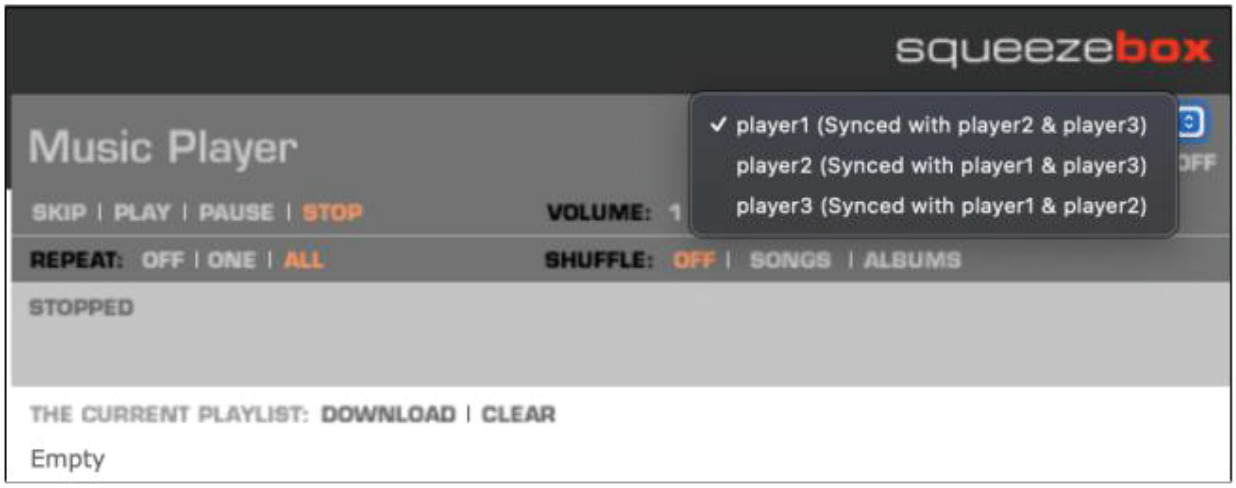

588. After pressing the "OFF" button in the Web UI's Music Player pane to power off player2, the Web UI shows all players as unsynced.




589. Although all players are treated as unsynced when only player1 is on, the preferences file still shows all three players in the same sync group.

```
[vmuser@slimserver conf]$ grep -P 'playername|syncgroupid' slimserver.conf
0f:59:51:64:dc:d7-playername = player2
0f:59:51:64:dc:d7-syncgroupid = 482986368
51:93:a5:ad:53:20-playername = player3
51:93:a5:ad:53:20-syncgroupid = 482986368
bc:39:f3:c4:1e:29-playername = player1
bc:39:f3:c4:1e:29-syncgroupid = 482986368
```

590. After powering on player2 and player3, the Web UI shows all three players synchronized again.




591. Now turning to the example cited above, it is clear that even after player1 receives the first and second indications adding it to the two different groups, it continues to operate in standalone mode (e.g., playing music independently of the other members of the group or not playing music that the group is playing) until one of the groups is selected for invocation. That may take place by turning on the standalone player or the non-standalone players in the group such that each member of the group plays back music based on the play command in synchrony.

1) Obviousness - POSITA

592. In the alternative, it would have been obvious to a person of skill in the art to allow the Zone Players to remain in standalone mode as claimed. Indeed, the inventor wrote that there were only three possibilities for the behavior when a speaker is added to a group, as shown below in an excerpt from the provisional appendices in numbers 1-3.

**1.1.3 What happens to the Music that's already playing when a Zone Scene is started.**

If no music is playing in any Zone – then the zones will simply link in a group.

If music is playing in one or more zones there are several possibilities (TBD)

1. The Music Queue in the zone group that was formed by the Zone Scene will be empty. In other words – the music will stop in any room that is part of the Zone Scene. This is the simplest solution, but may lead to frustration.

2. The user gets to choose from which of the ;joining' Queues the new zone group should play. This could be in the form of a dialog:

**What should the new Zone Group play?**
No Music
Track 1
Track 2
Radio Station A

Note that this method would only be useful (and possible) with simple Zone Scene grouping. With Advanced Zone Scene groupings, this dialog would become much too complicated.

3. In the case where only one of the zones in the new group was playing music, the new group should take the music (and Queue) of that zone.

SONOS-SVG2—00167534 at 167537.

593. However, there are actually four possibilities for actions when a speaker is added to a group, not three, because none of the above are actually claimed, as I describe in Section XI. A person of skill in the art would have found it obvious to choose from one of these possibilities—stop music, choose music, adopt the music of the only playing speaker, and continue playing the "standalone" music—when adding a speaker to a group. These are a limited number of obvious design options.

1) Obviousness - Millington

594. Further, a person of skill in the art would have been motivated to combine Squeezebox with Millington. They are both in the same field of endeavor—control of speaker systems, speaker groups, synchronous playback of speakers, and home audio systems—and they

both describe the same features and devices (e.g., "zone players") in the same language. Further, a person of skill in the art looking to Squeezebox would have also reviewed materials authored by one of the engineers, like Mr. Millington, that was working on the Sonos System to learn more about its capabilities given that Squeezebox and Sonos were competitors.

February 07, 2005 | PLAYLIST

# Review: Sonos Digital Music System

## Innovative system's similarities to the iPod are more than skin deep.

*By Dan Frakes*

It used to be that listening to music at home happened mainly in one place—the room where all your CDs or, for us old-timers, LPs and cassettes were stored. A few houses had cheezy intercom-based speakers spread throughout the house, but these ugly wall consoles generally sat there, unused, a remnant of 1970s experiments in "cutting edge" technology. Upper-income-bracket audio geeks were able to install better whole-house audio systems, but these were rare.

That was then. Over the past few years, two technological trends have taken hold that promise to significantly change the face of home music listening. The first is the popularity of digital music. And by that I don't mean CDs, but rather the storage and playback of music data files: MP3s, AACs, AIFFs, WAVs, etc. More and more people are storing their entire music collection on computers, iPods, and other high-capacity media.

The second trend is the increasing pervasiveness of wireless data networks in the home. Nowadays, most people either have a wireless home network or know someone who does. It's safe to say that in the not-too-distant future, wireless home networks will be as common as wired telephones.

I bring up these two trends because of their inevitable convergence. It's only a matter of time before your average consumer realizes that if they have all their music stored in a format that can be sent over a wireless network, they should be able to listen to *any* of their music *anywhere* in their home at *any* time.

Several companies have attempted to bring this convergence to the masses, including Apple via its AirPort Express with AirTunes, Slim Devices with its Squeezebox, and Roku with its SoundBridge units. But each of these systems has significant flaws—an AirPort Express system can only play to a single room and has no screen; the Roku units can't sync across multiple rooms; and the Squeezebox, which probably does the most right, still doesn't make it easy to navigate large music collections. The market is ripe for a product that does the whole-house-music thing right.

IA at 202.

## How much is it gonna cost me?

Alas, all this technology isn't cheap. ZonePlayers retail for $499 each, with Controllers at $399 each; a "starter" set of two ZonePlayers and a single Controller is $1199. Although these prices may seem high to many consumers, it's important to keep in mind that each ZonePlayer is, as mentioned above, an integrated amplifier, wireless base station, and digital-to-analog converter in one small unit; $499 doesn't seem so steep when you consider how much it would cost to buy similar components separately. It's also helpful to put the Digital Music System in context—it's designed to replace multi-room, built-in audio systems that often cost upwards of $10,000 for multiple rooms. For a budget of $2600 plus speakers, you can provide custom audio to four rooms with two Controllers.

Another way to look at the value of the Digital Music System is to consider what you would need to purchase to get similar functionality using other products. For example, you could purchase several of Apple's AirPort Express units at $129 each to deliver audio to different rooms. But you'd also need to purchase stereo systems for each room, you couldn't listen to music in more than one room at once, and you wouldn't be able to view and control the music being played without purchasing a laptop. Slim Devices' Squeezebox units provide a small screen and remote control, as well as a "synchronized play" option, but you're still talking $280 for each Sqeezebox, plus you'd again need to buy a stereo for each room at a few hundred bucks (at least) a pop. That's about the same price as the Sonos with many of the other limitations of the AirPort Express system.

IA at 205.

My test setup included a ZP80 along with a pair of ZP100's (pictured at left), a C100, and a pair Sonos Speakers. I have also hooked up a pair of Carver HT5.1 bookshelf speakers to one ZP100 and an Altec Lansing self-powered satellite-subwoofer PC speaker system to the ZP80.

**Pricing: It Depends On Your Point Of View**

What's unique about the Sonos' pricing is that it is either extremely expensive or a significant bargain, depending on your point of view. The Sonos ZonePlayers are $499 each for the ZP100 (the one with a built-in amplifier) and $349 for a ZP80 (the one without the amplifier). ZoneControllers cost $399 each, speakers are $179, charging docks for the ZoneController are $49, and a spare charger cables is another $19. The least expensive bundle is $999, which will be fine for many users, but expects users to both BYOS and BYOA.

This pricing makes technical early adopters scratch their heads and whine that compared to most streaming audio players, the Sonos is wildly overpriced. The Omnifi Simplefi I've had in the house for a couple of years, along with products from Pinnacle, Roku, Squeezebox, Linksys, and Apple, all cost between $129 and $299. Other options are mating an iPod with an Apple, Klipsch, or Bose audio dock: presto! music wherever you are. Finally, a cheapskate friend pointed out that boomboxes cost $39 at Target and can also put music in your room. If you'd be happy with a boombox - or even an iPod and an Apple HiFi - then the Sonos is clearly too expensive.

At the other extreme, a custom installed system can cost tens of thousands of dollars for a multi-zone setup that would cost $3,000 or $4,000 with a Sonos. In this respect, the Sonos is an incredible bargain.

The problem with the iPod and boombox is that they are single zone solutions - when you leave that room, you leave your music (and the boombox will only be able to play a fraction of your music collection, digitized or not). True, you could put a speaker dock in every room of your house and move the iPod with you, and if you live alone, this is a perfectly valid solution, but even then you need to move the iPod every time you leave the room, and it's hardly sufficient for a party.

The problem with most streaming media players is that they are either single zone (Apple, Linksys), cannot selectively synchronize music among multiple zones (all but the Squeezebox), have no display for selecting music to play (Apple, Linksys), have only a basic user interface (all), require a reasonable level of comfort with technology for setup (all except the Apple), and cannot accept music from remote sources and stream that around (all).

IA at 227.

595. Millington discloses "synchrony groups," which correspond to the synchronization groups disclosed in Squeezebox. Millington notes that "[a] user, using the user interface module 13, can enable a zone player 1 l(n) that is currently not a member of a synchrony group to join a synchrony group, *after which it will be enabled to play the audio program that is currently being played by that synchrony group*." Millington at 7 (emphasis added); *see also id.* at 8 ("Contemporaneously, the zone player 1 l(n) can notify the master device of the synchrony group that it (that is, zone player 1 l(n)) is joining, after which the master device can begin transmission of audio information and timing information to that zone player 1 l(n). The zone player 1 l(n) can thereafter begin playback of the audio program defined by the audio information, in accordance with the timing information so that the zone player 1 l(n) will play the audio program in synchrony with the master device."); *id.* at 41 ("The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device."). Accordingly, Millington discloses that even when a zone player is added to a zone group (*i.e.*, synchrony group), that it is only *enabled* to play the audio program playing in the synchrony group, but it does not necessarily play that audio immediately. Instead, the zone player must later transition to synchronous playback, as the claims require.

596. Further, as discussed above, a person of skill in the art would have been motivated to combine the Sonos System with Millington. They are both in the same field of endeavor—control of speaker systems, speaker groups, synchronous playback of speakers, and home audio systems—and they both describe the same features and devices (*e.g.*, "zone players") in the same language. Further, a person of skill in the art looking to the Sonos System would have also reviewed materials authored by one of the engineers, like Mr. Millington, that was working on the

Sonos System to learn more about its capabilities.

597. Millington discloses "synchrony groups," which correspond to the zone groups disclosed in the Sonos System. Millington notes that "[a] user, using the user interface module 13, can enable a zone player 1 l(n) that is currently not a member of a synchrony group to join a synchrony group, *after which it will be enabled to play the audio program that is currently being played by that synchrony group*." Millington at 7 (emphasis added); *see also id.* at 9 ("Contemporaneously, the zone player 1 l(n) can notify the master device of the synchrony group that it (that is, zone player 1 l(n)) is joining, after which the master device can begin transmission of audio information and timing information to that zone player 1 l(n). The zone player 1 l(n) can thereafter begin playback of the audio program defined by the audio information, in accordance with the timing information so that the zone player 1 l(n) will play the audio program in synchrony with the master device."); *id.* at 41 ("The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device."). Accordingly, Millington discloses that even when a zone player is added to a zone group (i.e., synchrony group), that it is only *enabled* to play the audio program playing in the synchrony group, but it does not necessarily play that audio immediately. Instead, the zone player must later transition to synchronous playback, as the claims require.

598. Millington further discloses keeping a media player in standalone mode after joining a group, because players disclosed by Millington continue to operate independently of the newly joined group. Millington at 7("As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.").

599. Millington discloses that speakers may be enabled to play back music in a group when they join that group, but do not necessarily do so. *Id.* ("A user, using the user interface module 13, can enable a zone player 11(n) that is currently not a member of a synchrony group to join a synchrony group, after which it will be enabled to play the audio program that is currently being played by that synchrony group.").

1) Obviousness - Rajapakse

600. It would have been obvious to combine Rajapakse with Squeezebox for the reasons discussed above. As discussed below, Rajapakse discloses this claim limitation.

601. Rajapakse discloses keeping speakers in a standalone mode. Rajapakse, 14:37-40 ("Also it is possible to have the media renderers in no specific zone, which can be considered as equivalent to the media renderers being in zone 0 or a default zone.").

602. Rajapakse discloses that after being added to a zone, the media renderer (speaker) may be playing or idle, so it may not be invoked by any zone (i.e., in standalone mode). Rajapakse, 7:52-56 ("The identity information includes the media renderer's identifier, its set of assigned zone identifiers (ZIDs), and its role within each zone, and known default stream identifiers for each zone. The current state information includes its current playing state: playing or idle."). Sonos described "standalone mode" this way in its summary judgment brief, as discussed above.

603. Rajapakse discloses dynamic grouping and transitioning speakers among groups. Rajapakse, 3:65-4:2 ("If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.").

604. Rajapakse also discloses that the user may select which zone to invoke from many different zones. Rajapakse, 8:34-40 ("After zone manager discovery 602, the zone control point

209 retrieves zone information from each zone manager 210 and the zone control point 209 then uses this information to select a zone from the available set of zones. This selection may be an auto selection from the available zones (ZIDs) based on some preset criteria, such as signal strength, or based on user selection. . . . This process allows the user and zone control point 209 to get information on the zone, view media available to play on the zone and then make a selection.").

605. Rajapakse discloses transitioning from one zone to another or transitioning from not playing music to playing music. Rajapakse, 8:67-9:2 ("If a new zone control point 209 requests the zone, the previous zone control point 209 can release the reservation.").

606. Rajapakse discloses transitioning from one zone manager to another. Rajapakse, 9:35-44 ("If a media renderer 203 is already registered with another zone manager when the registration request comes in, and the registration request passes authentication, before responding, the media renderer 203 will notify 707 its current zone manager of the registration request from the new zone manager and ask for permission to deregister. If the current zone manager does not respond to this deregistration request within a timeout period, the media renderer 203 will assume approval and accept the new registration request from the new zone manager.").

607. Rajapakse discloses forcing a transition of a media renderer from one zone to another. Rajapakse, 9:57-59 ("The user may, via the zone control point 209, cause the zone manager 210 to send a force registration 703 request to a media renderer.").

1) Obviousness - Lindemann

608. It would have been obvious to combine Lindemann with Squeezebox for the reasons discussed above. As discussed below, Lindemann discloses this claim limitation.

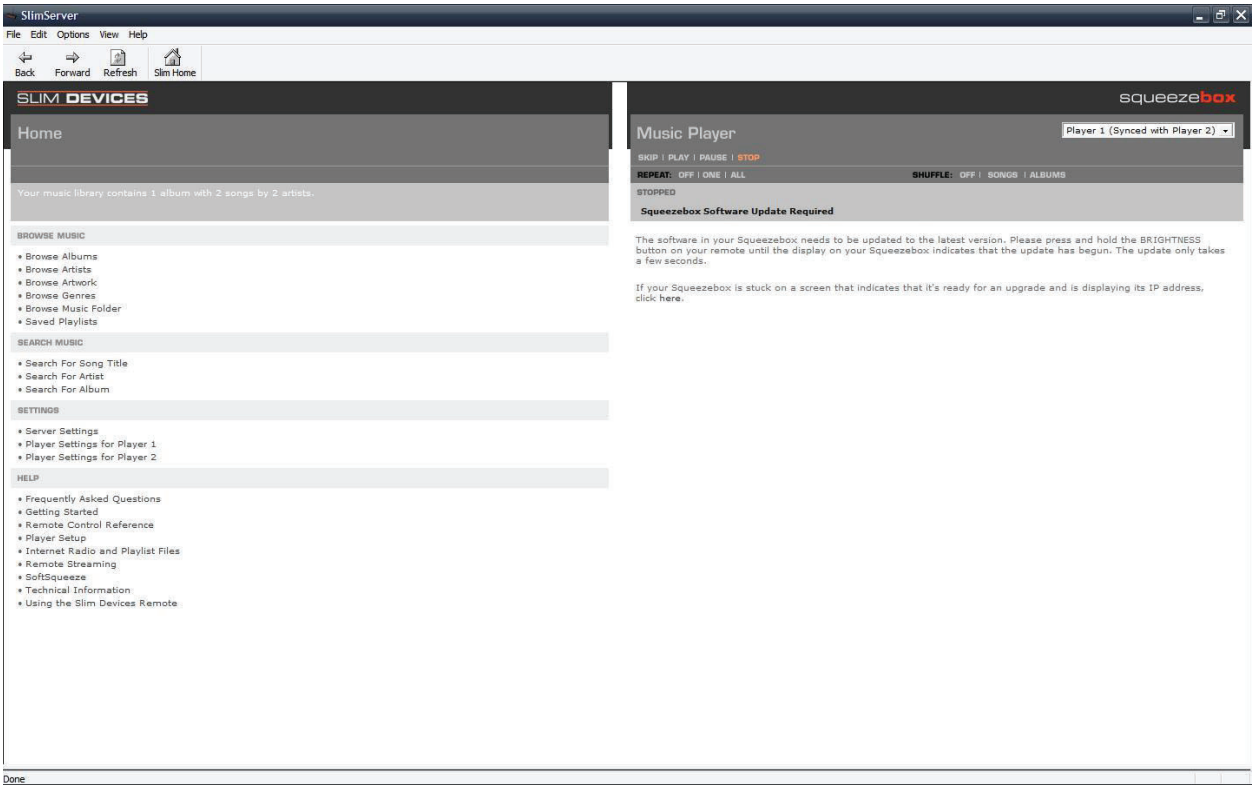
609. Lindemann discloses selectively activating the speaker based on group membership, before or after that speaker was joined to a group. Lindemann at Cl. 9 ("9. The speaker of claim 2, further comprising means, responsive to a control signal in the status data for

assigning the speaker to a speaker group, for selectively activating the speaker based on the speaker group to which the speaker is assigned.").

(x) *Limitation 1.9: "after the given one of the first and second zone scenes has been selected for invocation, receiving, from the network device over the data network, an instruction to operate in accordance with a given one of the first and second zone scenes respectively comprising a given one of the first and second predefined groupings of zone players; and"*

610. In my opinion, Squeezebox discloses this claim limitation.

611. In Squeezebox, a user may select a synchronization group for playback using the player selector in the upper right corner of the SlimServer. The SlimServer provides playback controls in the Music Player section to cause the Squeezeboxes to operate as a synchronous playback group.



612. The source code confirms that this claim limitation is met.

613. When a "play" command is sent to a player, for example by pressing the "PLAY" button in the Web UI, SlimServer sends a 'strm' SlimProto command to the player to play the master's current song. *See, e.g.*:

Slim::Web::HTTP::processURL(), Slim/Web/HTTP.pm (v5.3.1), 483–581 at 575

Slim::Control::Command::execute(), Slim/Control/Command.pm (v5.3.1), 24–713 at 216

Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at 327–343, 393 Slim::Player::Squeezebox::play(), Slim/Player/Squeezebox.pm (v5.3.1), 99–107 at 104 Slim::Player::Squeezebox::stream(), Slim/Player/Squeezebox.pm (v5.3.1), 404–512 Slim::Player::Squeezebox::sendFrame(), Slim/Player/Squeezebox.pm (v5.3.1), 514–533

**Command: "strm"**

This takes 16 bytes data of the form:

| | | |
|---|---|---|
| $command | 1 byte | 's' start, 'p' pause, 'u' unpause, 'q' stop |
| $autostart | 1 byte | (buffer threshold to start playing at) '0' off, '1' 25%, '2' 50%, '3' 75%, '4' 100% |
| $formatbyte | 1 byte | 'p' for pcm data, 'm' for mp3 |
| $pcmsamplesize | 1 byte | '0' = 8, '1' = 16, '2' = 20, '3' = 32 usually '1' ('?' for mp3) |
| $pcmsamplerate | 1 byte | '0'=11kHz, '1'=22kHz, '2'=32kHz, '3'=44.1kHz, '4'=48kHz usually '3' ('?' for mp3) |
| $pcmchannels | 1 byte | '1'=mono, '2'=stereo usually '2' ('?' for mp3) |
| $pcmendian | 1 byte | '0' = big, '1' = little ('1' for wav, '0' for aif, '?' for mp3) |
| $prebuffer_silence | 1 byte | usually 5 (mpeg prebuffer x frames of silence) |
| $spdif_enable | 1 byte | '0'=auto, '1'=on, '2'=off usually 0 |
| | 1 byte | reserved |
| $server_port | 2 bytes | Server Port to use (9000 is the default) |
| $server_ip | 4 bytes | 0 means use IP of control server |

This is followed by an HTTP header itself. This is used to obtain the stream data eg:

GET /stream.mp3?player=$client-id HTTP/1.0
(Authorization: Basic $password)
(blank line)

The Auth line is only sent if authorization is in use. $client-id is the usually the MAC address of the player and $password is a password generated by the server.

http://:9000/html/docs/slimproto.html

HTML/EN/html/docs/slimproto.html

614. Any changes to the play mode, including starting play, are also done on all the synced clients that are not silent.

**Slim/Player/Source.pm (v5.3.1)**

```
# when we change modes, make sure we do it to all the synced clients.
foreach my $everyclient ($client, Slim::Player::Sync::syncedWith($client)) {

        $::d_source && msg($everyclient->id() . " New play mode: " . $newmode . "\n");

        next if Slim::Utils::Prefs::clientGet($everyclient,'silent');
```

...

**Slim/Player/Source.pm (v5.3.1)**

```
} elsif ($newmode eq "play") {

        $everyclient->readytosync(0);
        $everyclient->volume($client->volume(),1);
        $everyclient->streamBytes(0);
        $everyclient->play(Slim::Player::Sync::isSynced($everyclient), $master->streamformat());
```

Slim::Player::Source::playmode(), Slim/Player/Source.pm (v5.3.1), 285–438 at 345–350, 388–393

615. The evidence relevant to this claim limitation is recited in the prior limitation described above. The power on (grfd, i2cc) instructs the Squeezebox or Softsqueeze players to operate in accordance with the group.

*(xi) Limitation 1.10: "based on the instruction, transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players such that the first zone player is configured to coordinate with at least one other zone player in the given one of the first and second predefined groupings of zone players over a data network in order to output media in synchrony with output of media by the at least one other zone player in the given one of the first and second predefined groupings of zone players."*

616. In my opinion, Squeezebox discloses this claim limitation.

617. The evidence disclosing this claim limitation is described above, which transitions the Squeezebox or Softsqueeze player from playing (or not playing) independently of the group to play in accordance with the group. As described above, the Squeezeboxes coordinate through master and slave communication to output music in synchrony, and the strm/play messages cause the speaker to operate in accordance with the claimed "zone scene."

618. Further, as described in the previous claim limitation, a user may select a synchronization group for playback using the Player selector box, and use the playback controls to cause the Squeezeboxes to operate as a synchronous playback group. At the time that the synchronization group is selected and media is output from the synchronization group, the Squeezeboxes discontinue their previous playback and begin playing back as part of the synchronization group.

**C. Claim 1 Is Invalid Based On Bose Lifestyle in view of General knowledge of a POSITA, the Sonos PA System, the Sonos Forums, or Millington.**

619. Bose Lifestyle 50 System ("Bose Lifestyle") was publicly available, on sale,

offered for sale, and described in printed publications both before the critical date (i.e., prior to September 12, 2005), before the alleged conception date (i.e., prior to December 21, 2005), and prior to the patent filing date on September 12, 2006. The features offered in that system were substantially the same during each of those time frames, as discussed below.

620. The capabilities and features of the Bose Lifestyle are apparent from documents that Bose has made available to the public and produced in this case, the products themselves, technical documentation, public documentation regarding that system, professional and customer reviews, and other sources discussed below.

621. In my opinion, Claim 1 is rendered obvious based on the Bose Lifestyle in view of the general knowledge of a POSITA, the Sonos Forums, Nourse, Millington, and Rajapakse, as described below. Below, I analyze each element of Claim 1 and demonstrate why that claim is invalid.

*(i) Limitation 1 (preamble): "A first zone player comprising:"*

622. To the extent the preamble is limiting, Bose Lifestyle discloses the preamble in my opinion. For example, the Bose Lifestyle was publicly available no later than October 17, 2001. The Bose Lifestyle player corresponds to the claimed Zone Player and it provides the ability to stream digital music from a controller over a Wi-Fi or ethernet network. It can plug into any home theater stereo or speakers with digital and analog outputs, and allows a user to synchronize multiple players for whole house audio.

Thank you for purchasing the Bose® Lifestyle® 50 system. Years of research lie behind this complete audio home entertainment system – the most advanced home theater system from Bose. Technological innovations that make the Lifestyle® 50 system unique include the Bose Personal™ music center, which places all system operations in the palm of your hand, and tiny Jewel Cube® speakers.

The interactive Personal music center is a clear departure from convention, communicating with the system through a two-way radio data link. The result for you is full control of this entertainment system as you move about your home.

The Bose Jewel Cube speakers are also far from conventional. Proprietary technologies ensure that these tiny speakers not only fill a room with sound, but also reproduce it more accurately than traditionally designed loudspeakers.

The other elements of the Lifestyle® 50 system are designed to be hidden from view:

- The elegant Lifestyle® CD changer, designed to give you flexibility in where it is placed
- The hideaway powered Acoustimass® module that delivers the rich, full, lifelike bass
- The Bose multi-room interface, with four independent audio outputs that allow you to enjoy Bose sound throughout your home.

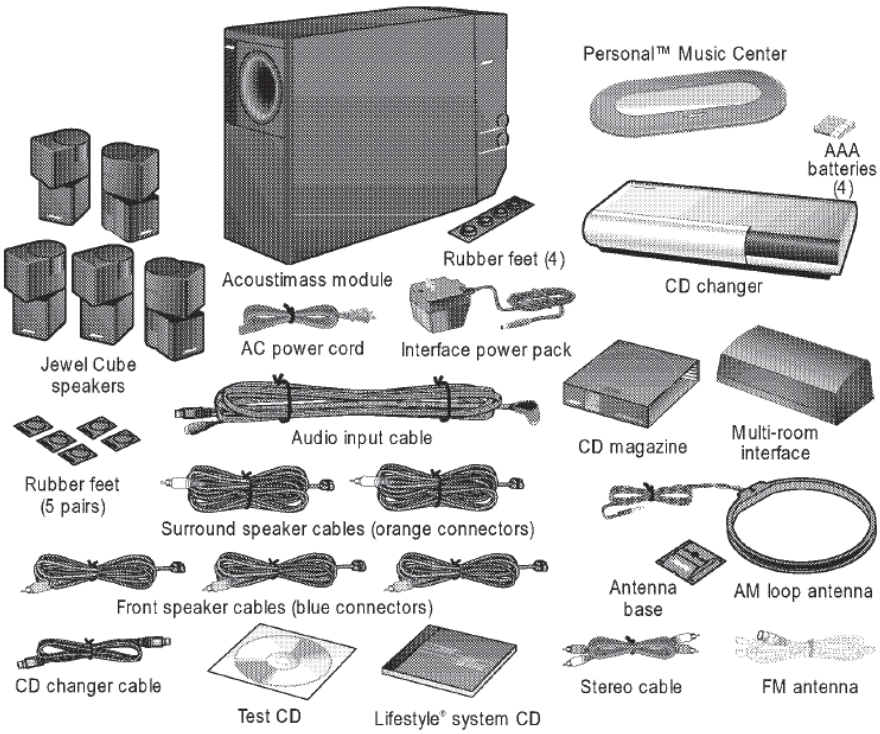
BOSE_SUB_0000006.

623. As shown below, the Bose Lifestyles connects the controller (for example a computer) and a speaker system.

**Figure 1**

*What comes with your Lifestyle® 50 system:*

- Personal music center
- CD changer
- Multi-room interface
- Interface power pack*
- 5 Jewel Cube® speakers
- 5 speaker cables
- Acoustimass module
- AC power (mains) cord*
- 14 self-adhesive rubber feet (4 for the module and 5 pairs for the Jewel Cube speakers)
- Audio input cable
- CD changer cable
- Stereo cable
- 4 AAA batteries
- FM antenna
- AM loop antenna
- AM antenna base
- CD magazine
- Lifestyle® system CD
- Test CD




* *Power cord and pack shown above are USA/Canada/Japan versions. Dual voltage systems include 1 power cord, 1 adapter, and 2 power packs. The power cords and packs for Europe, UK/Singapore, and Australia are shown below.*

*Id*.

624. Further, the Bose LifeStyle allows a user to select a location for the multi-room interface.

**Figure 5**

*The multi-room interface*

**Multi-room interface**

Select a location for the multi-room interface. It may be placed out of sight if you like.

1. Place the multi-room interface within 30 feet (9.1 m) of the Acoustimass module (the length of the audio input cable).
2. Place the multi-room interface close enough to the sound sources (TV, VCR, DVD, etc.) to allow for cable length. If you need additional audio and/or video cables to connect all of your components, see your dealer or call Bose® Customer Service.

BOSE_SUB_00000010.

Contains Highly Confidential AEO and Source Code Materials



## Connecting additional rooms

Follow the placement guidelines for the Bose® powered speakers that you plan to connect. Then review your plan for how to connect these speakers to the multi-room interface in your primary room. If you have questions or need extension cables to complete the connections, call Bose Customer Service at the numbers listed on the back inside cover of this owner's guide.

**CAUTION:** *Make sure all components are unplugged from the power outlet before you begin hooking up additional speakers.*

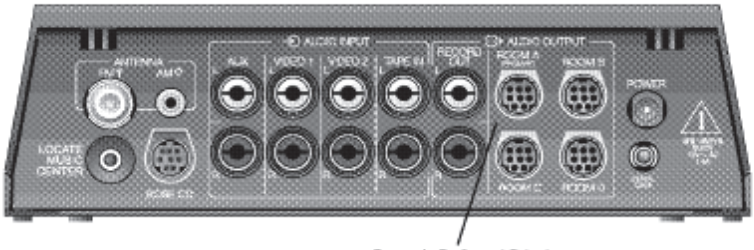
Connect the audio input cable from your additional powered speakers to the selected ROOM jack on the back of the multi-room interface.

1. Plug the small black multi-pin connector (flat side facing up) into the jack marked ROOM B, C, or D on the back of the interface.
2. Follow the instructions that came with your speakers for connecting the cable to the speakers.

**Note:** *Be sure that each connector is inserted completely into each jack.*

**Figure 47**

*ROOM jacks on the multi-room interface*




Room A, B, C, and D jacks



BOSE_SUB-0000042

BOSE_SUB-00000042.

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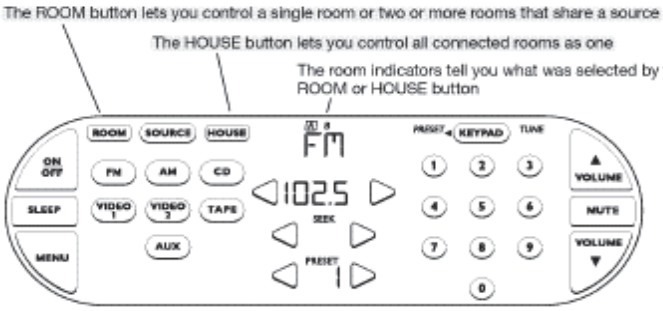
## Operating in more than one room

Your Lifestyle® 50 system can control up to four sets of Bose® powered speakers, allowing your family to enjoy different audio sources (CD, radio, TV, etc.) in up to four rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal™ music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 48 shows an example display for a two-room system.

**Figure 48**

*Example display for a two-room system*




### Understanding the room indicators

- A boxed letter indicates the presently-selected room or rooms. The selected room is affected by any source changes, or any change you make using the VOLUME, MUTE, ON/OFF, or SLEEP buttons.
- B An unboxed letter indicates a room listening to a ***shared source***. A shared source is one that is playing in the controlled room as well as in up to three additional rooms. If you change the radio station, CD track, etc., of the shared source, the change affects all rooms sharing this source. However, you cannot change sources for all affected rooms at the same time. The VOLUME, MUTE, ON/OFF, and SLEEP buttons only affect the boxed room(s).
- An empty box appears for each connected room when you press the HOUSE button. When you change the volume in the HOUSE mode, the numerical level appearing on the display does not represent the actual volume level in all connected rooms. It only represents the actual volume in rooms represented by a boxed letter.





BOSE_SUB-0000043.

625. I understand that Sonos does not dispute that Bose Lifestyle discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Bose Lifestyle. I have reviewed

Sonos's response ("Validity Contentions") as it relates to the Sonos System and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 106-107.

*(ii) Limitation 1.1: "a network interface that is configured to communicatively couple the first zone player to at least one data network;"*

626. In my opinion, Bose Lifestyle discloses this claim limitation.

627. For example, Bose Lifestyle discloses a network interface including both Wi-Fi and ethernet capabilities that couples the Bose Lifestyle to a data network existing at least between the Bose Lifestyle and the controller.

**Automatic sound level monitoring and control**

Your enjoyment of movies is enhanced by Digital Dynamic Range® compression. This technology automatically monitors and adjusts the volume to let you to hear soft sounds, particularly dialogue, but prevents you from being overwhelmed by loud special effects. This is especially useful for late night viewing – it eliminates the need to constantly adjust the volume.

*Id.* at 4.

628. As shown below, the Bose LifeStyle connects the controller and a speaker system.

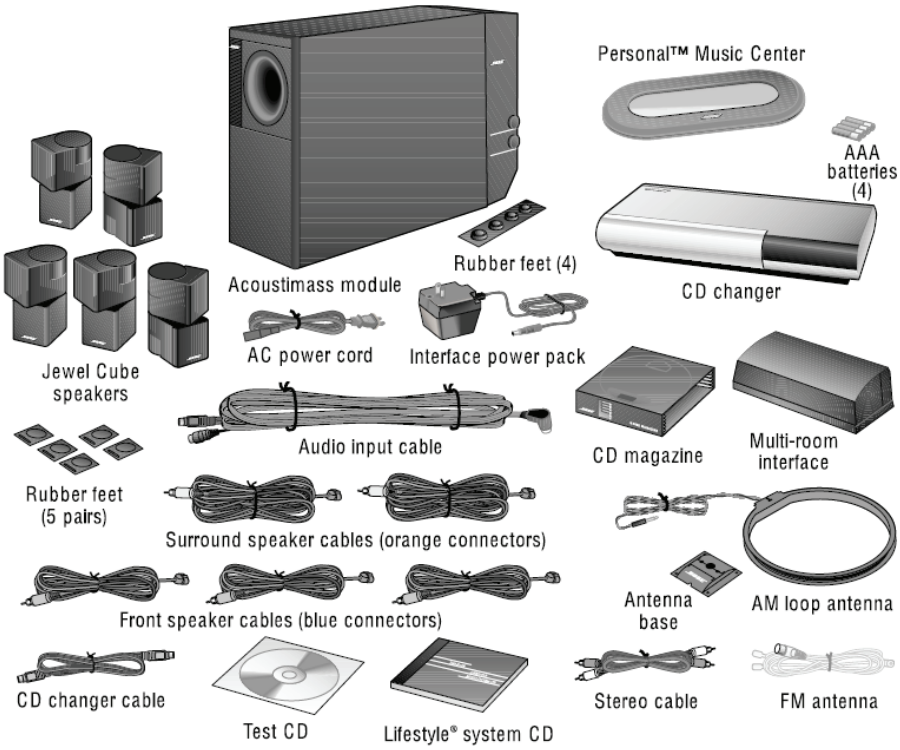
When you place your speakers according to the guidelines below, a combination of reflected and direct sound provides the audio atmosphere of a home theater. You may experiment with the placement and orientation of the Jewel Cube® speakers and Acoustimass® module to produce the sound most pleasing to you. For more discussion of speaker placement and room acoustics, see "Fine-tuning your system" on page 36.

*Id.*

**Figure 1**

*What comes with your Lifestyle® 50 system:*

- Personal music center
- CD changer
- Multi-room interface
- Interface power pack*
- 5 Jewel Cube® speakers
- 5 speaker cables
- Acoustimass module
- AC power (mains) cord*
- 14 self-adhesive rubber feet (4 for the module and 5 pairs for the Jewel Cube speakers)
- Audio input cable
- CD changer cable
- Stereo cable
- 4 AAA batteries
- FM antenna
- AM loop antenna
- AM antenna base
- CD magazine
- Lifestyle® system CD
- Test CD




*Id.* at 8.

629. Bose LifeStyle also describes connecting its JewelCube speakers to the Acoustimass module, and being able to match each cable to the corresponding speaker location.

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### Connecting the Jewel Cube® speakers to the Acoustimass® module

1. Match each cable to the corresponding speaker location.
   - Front speaker cables have blue RCA connectors at one end, with L, R, or C molded into both the RCA connectors and the Jewel Cube connectors at the other end.
   - Surround speaker cables have orange RCA connectors at one end, with L or R molded into both the RCA connectors and the Jewel Cube connectors at the other end.
2. Insert the Jewel Cube connector of each cable fully into the jack on the rear of one of the five speakers (Figure 7). Match the ridge of the connector to the notch at the top of the jack.
3. Connect each cable to the corresponding jack on the Acoustimass module (Figure 8).
   - Plug the blue connectors into the matching left front, center, and right front jacks.
   - Plug the orange connectors into the matching left surround and right surround jacks.

To lengthen the cable, connect speaker wire with male phono (RCA) plugs on each end to your supplied speaker cable. Use a female-to-female adapter ("barrel" connector). Or, splice in 18-gauge (.75 $mm^2$) or thicker cord (connecting + to + and – to –). To purchase extension wire, see your dealer or electronics store, or call Bose® Customer Service.

### Connecting the Acoustimass® module to the multi-room interface

Connect the module to the interface with the audio input cable (Figure 8).

1. Insert the right-angle multi-pin connector on the audio input cable into the AUDIO INPUT jack on the module. Align the connector at the angle shown in Figure 8.
2. Plug the small black multi-pin connector (flat side facing up) into the jack marked ROOM A (PRIMARY) on the back of the interface.

♪ **Note:** *The female RCA connector on the audio input cable is for connecting the digital output of a DVD player or other digital source to the system. See "Setting up a digital sound source" on page 12.*

♪ **Note:** *Be sure that each connector is inserted completely into each jack.*

For information on connecting multi-room systems, see "Connecting additional rooms" on page 40.

### Connecting the CD changer to the multi-room interface

Connect the CD changer to the interface with the CD changer cable (Figure 8).

1. Plug a blue multi-pin connector (flat side facing up) into the jack marked BOSE CD on the back of the interface.
2. Plug the other blue multi-pin connector (flat side facing left) into the jack marked BOSE CD on the back of the CD changer.

*Id.* at 9.

630. It is also my opinion that Bose Lifestyle discloses multiple configurations for setting up a speaker configuration: (1) directly to the Lifestyle multi-room interface, and (2) using a stereo TV as the switching center to select the sound source.

## How to set up your home theater

There are two basic methods for setting up your home theater. It is best to connect components directly to the Lifestyle® 50 multi-room interface, and select the sound source using the Personal™ music center. A second option is to use a stereo TV as the switching center to select the sound source. In each example, the analog outputs from the DVD player or other digital device are connected to the AUX inputs. You may need extra long audio cables or extensions for some of these connections.

*Id.* at 13.

**Figure 12**

*Preferred home theater connections to the Lifestyle® 50 system*

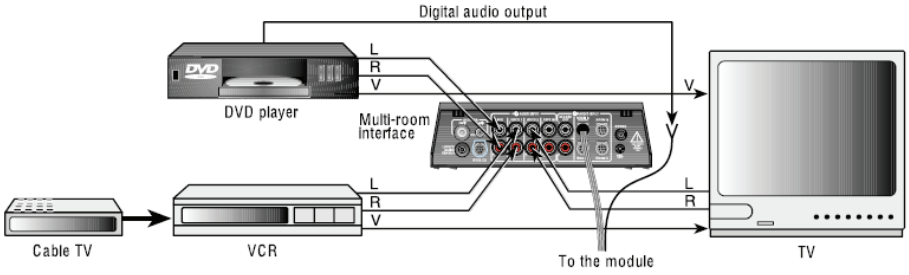
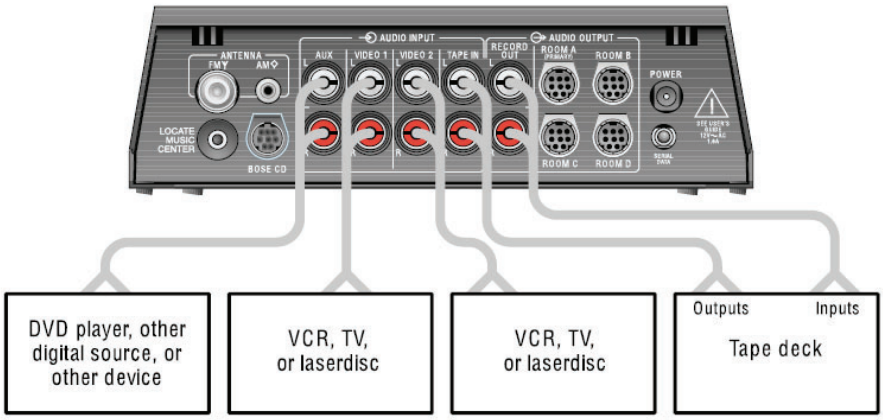



**Figure 14**

*Connecting external components*




*Id.* at 15

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## Setting up the Personal™ music center

Set up the Personal music center after the rest of the system is connected and plugged in.

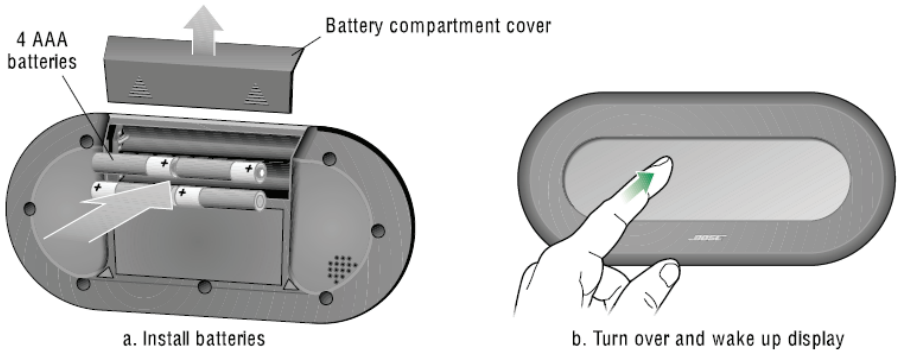
♪ ***Note:*** *When batteries are first installed in the music center, it sets up a radio-frequency link with the closest multi-room interface.*

1. Hold the music center within a few feet of the multi-room interface.
2. Slide open the battery compartment on the back of the music center (Figure 17).
3. Insert 4 AAA or IEC-R03 1.5V batteries, or the equivalent, as shown. Match the + and – symbols on the batteries with the + and – markings inside the compartment.
4. Slide the battery compartment cover back into place.
5. Turn the music center over and touch the screen to wake it up if it appears blank. Press ON/OFF, FM, or any other source button to turn the system on.

***If the music center continuously displays "NO RESPONSE,"*** you need to try to establish its link with the multi-room interface again. Hold the music center close to the multi-room interface. Press and hold MUTE for about 5 seconds until you hear a beep and then release. After about 10 seconds, the music center should beep twice to confirm that the link is established.

***Figure 17***

*Installing batteries and waking up the display for the first time*




♪ ***Note:*** *Replace the batteries when the LOW BATTERY message first appears. See "Replacing batteries" on page 44. Alkaline batteries are recommended.*

*Id.* at 18.

## Turning on the system

You are ready to enjoy your new Lifestyle® system. Your Personal™ music center places complete control of the system operations in your hands. The center is portable, communicating with the rest of the system through a two-way radio-frequency link. The display is backlit for easy viewing, and provides visual feedback of current system operations and available options. To allow for maximum battery life, the display and backlight turn off a short time after your last button press. You only need to touch the screen to wake up the music center.

- To learn more about the display, see "Using the Personal music center display" on pages 20-21.
- To operate the AM/FM radio, see "Listening to the radio" on pages 26-28.
- To operate the CD changer, see "Listening to compact discs" on pages 29-34. To verify your system setup, listen to the instructions on the Test CD.
- To control external components, see "Using the system with external components" on page 35.
- To use your system in multiple rooms, see "Operating in more than one room" on pages 41-43.

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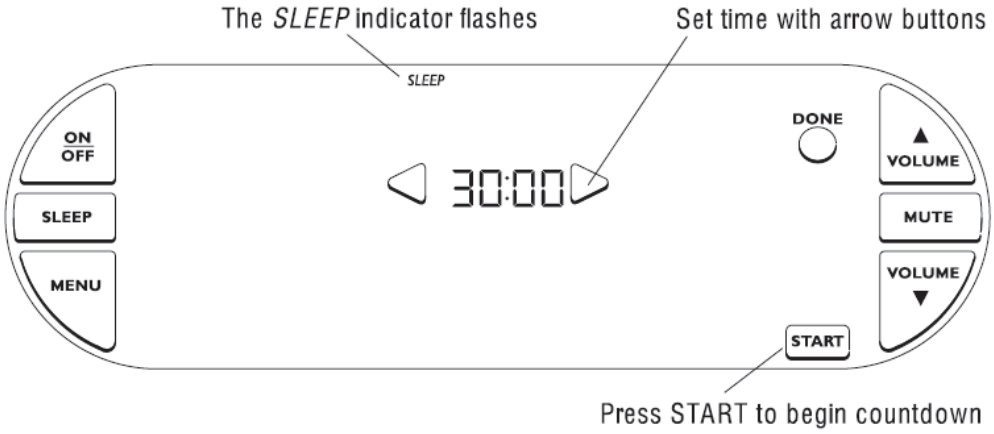
## Using the sleep timer

- Press the SLEEP button to access the sleep timer for automatic shutoff. The display flashes a sleep time of 30 minutes or the most recent sleep time setting (Figure 20). The *SLEEP* indicator is also flashing.
- Use the arrow buttons to set the sleep timer to 1 to 99 minutes.
- Press the START button to start the counter. The START button disappears and a CLEAR button appears at the bottom of the display.

***Before pressing START ...***




*Id.* at 20.

display

## Listening to the system

Your Lifestyle® 50 system uses digital signal processing to bring even greater realism and impact to both movies and music recordings. Built-in Dolby Digital decoding delivers up to 5.1 discrete audio channels (that is, five for the independent Jewel Cube® speakers and one for rich bass from the Acoustimass® module) from DVD, digital TV, next-generation cable boxes, and satellite receivers. With analog formats, as well as for two-channel PCM and Dolby Digital bitstreams, Videostage® decoding steers front information to the left, center, and right, and directs surround information to the left and right rear channels. As a result, the sound of stereo broadcasts and rented or recorded tapes can approach that of your DVD discs.

In addition, Videostage decoding can process a one-channel program and direct five-channel sound to five independent speakers. Dialogue remains locked on-screen, while music and ambient effects fill the room to increase your listening enjoyment.

You may choose to listen through two, three, or five speakers. Traditional stereo may be enjoyed through two or more speakers. Listening through three or five speakers helps anchor the dialogue of movies to the picture and provides a more solid image for music vocals. For the greatest surround effect, listening through five speakers gives you the most convincing sound experience.

631. Bose Lifestyle also provides for connecting speakers to a multi-room interface that resides in the user's primary room, and then provides for the ability to operate in multiple rooms.

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## Connecting additional rooms

Follow the placement guidelines for the Bose® powered speakers that you plan to connect. Then review your plan for how to connect these speakers to the multi-room interface in your primary room. If you have questions or need extension cables to complete the connections, call Bose Customer Service at the numbers listed on the back inside cover of this owner's guide.

**CAUTION:** *Make sure all components are unplugged from the power outlet before you begin hooking up additional speakers.*

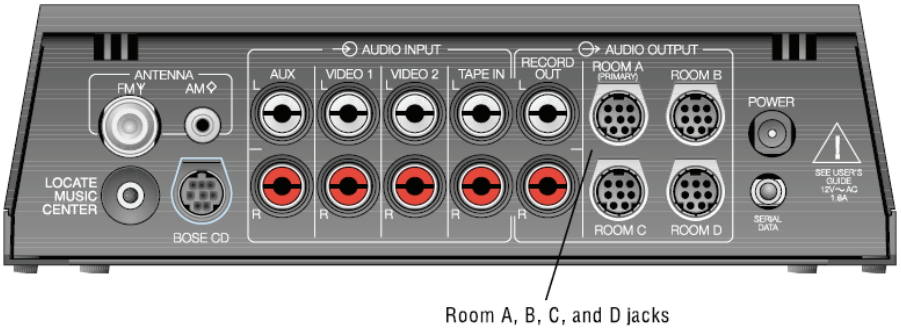
Connect the audio input cable from your additional powered speakers to the selected ROOM jack on the back of the multi-room interface.

1. Plug the small black multi-pin connector (flat side facing up) into the jack marked ROOM B, C, or D on the back of the interface.
2. Follow the instructions that came with your speakers for connecting the cable to the speakers.

**Note:** *Be sure that each connector is inserted completely into each jack.*

**Figure 47**

*ROOM jacks on the multi-room interface*




*Id.* at 40.

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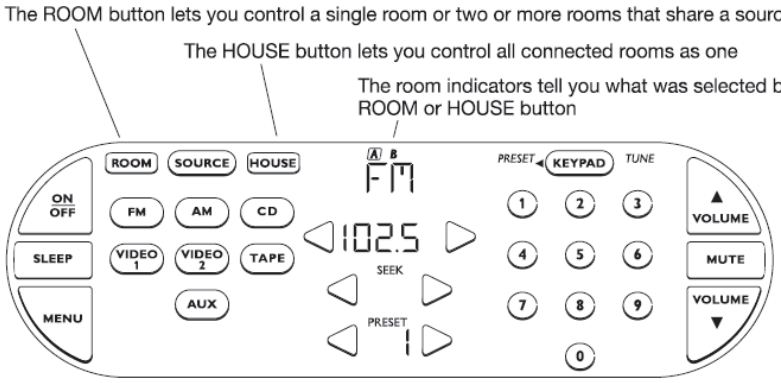
## Operating in more than one room

Your Lifestyle® 50 system can control up to four sets of Bose® powered speakers, allowing your family to enjoy different audio sources (CD, radio, TV, etc.) in up to four rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal™ music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 48 shows an example display for a two-room system.

**Figure 48**

*Example display for a two-room system*




### Understanding the room indicators

A A boxed letter indicates the presently-selected room or rooms. The selected room is affected by any source changes, or any change you make using the VOLUME, MUTE, ON/OFF, or SLEEP buttons.

B An unboxed letter indicates a room listening to a ***shared source***. A shared source is one that is playing in the controlled room as well as in up to three additional rooms. If you change the radio station, CD track, etc., of the shared source, the change affects all rooms sharing this source. However, you cannot change sources for all affected rooms at the same time. The VOLUME, MUTE, ON/OFF, and SLEEP buttons only affect the boxed room(s).

☐ An empty box appears for each connected room when you press the HOUSE button. When you change the volume in the HOUSE mode, the numerical level appearing on the display does not represent the actual volume level in all connected rooms. It only represents the actual volume in rooms represented by a boxed letter.

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## Using the ROOM button

The ROOM button allows you to select any connected room and control any sound source you want to hear in that room. Each time you press the ROOM button you can transfer control from one room to the next in A-B-C-D order. The room indicators on the display tell you what is currently selected. Rooms listening to a shared source can be linked and controlled as one room.

### Turning on different sources in more than one room

Let's say you have a two-room system (rooms A and B) and the entire system is off. To turn on a different source in each room:

1. Wake up the Personal™ music center.
2. Press the ROOM button until the room indicator [A] is displayed. Press a source button, such as VIDEO 1, to turn on the system and listen to your DVD player in room A. Adjust the volume to the desired level.
3. Press the ROOM button again. The room indicator [B] is displayed. Press a different source button, such as CD, to listen to a CD in room B. Again, adjust the volume to the desired level.
4. Press the ROOM button again and notice that the room indicator [A] is displayed. You are controlling room A once again and the displays indicates that the VIDEO 1 source is on.

### Setting up a shared source

Now, let's say the system is already on and you want to play the FM radio in rooms A and B:

1. Wake up the Personal music center.
2. Press the ROOM button until the room indicator [A] is displayed. Press the FM source button and adjust the volume to the desired level for room A.
3. Press the ROOM button again to select room [B]. Press the FM source button and adjust the volume to the desired level for room B. Now, the indicators A [B] are displayed.
4. Press the ROOM button again. The indicators [A] [B] appear on the display indicating that you can control these two rooms together. Any button command given now (SOURCE, VOLUME, MUTE, ON/OFF, SLEEP) is applied to both rooms.

**Note:** *Remember that there are limits to using different sources in different rooms. With one tuner, the system cannot play one radio station in one room and another radio station in another. Similarly, with one CD changer, the system cannot play two different CDs at the same time.*

## Linking rooms for common control

There are two ways to link rooms in order to control them as one.

- Set up a shared source in two or more rooms and select them together using the ROOM button. See "Setting up a shared source" above.
- Link all connected rooms using the HOUSE button. See "Using the HOUSE button" on page 43.

## Returning to single-room control

After you have gained control of multiple rooms using the ROOM button, you can use the ROOM button again to gain control of a single room. Press ROOM until the room you want is displayed ([A], [B], [C], or [D]). Control that room as desired.

*Id.* at 43.

### *Using the HOUSE button*

Using the HOUSE button, you can link all rooms together and control them as one. When you press the HOUSE button, an empty box indicator is displayed for each connected room. Any button pressed after that (any source button, VOLUME, MUTE, or SLEEP) affects every room. When you are done listening you can press OFF to turn off the entire system.

***Note:*** *If you do not press any additional buttons after pressing HOUSE, pressing HOUSE again cancels HOUSE mode.*

Press the HOUSE button before each command to apply that command to all rooms:

| **Press ...** | **To do this ...** |
|---|---|
| HOUSE then a source | Play the selected source in all connected rooms. |
| HOUSE then VOLUME ▲/▼ | Adjust the volume up or down by the same amount in all rooms that are on, or all connected rooms if they are all off. The system remembers the differences among the original room volume settings. |
| HOUSE then MUTE | Silence all connected rooms that are on, even if any were previously muted individually. To cancel this command, press HOUSE then MUTE again. Any rooms that were muted before this command was given stay silent until individually unmuted. If you unmute an individual room after it was muted by a HOUSE - MUTE command, the other rooms remain silent until each one is unmuted individually. Pressing HOUSE then VOLUME ▲unmutes all muted rooms. |
| HOUSE then SLEEP | Set the SLEEP timer for all rooms that are on. The SLEEP time selected applies to all rooms that are on even if they are playing different sources. If the SLEEP timer was already set in one or more rooms, the display shows the longest time already set. You can accept this time or change it for all the rooms. To cancel the HOUSE - SLEEP command, press HOUSE, SLEEP, CLEAR, and then DONE. |
| HOUSE then OFF | Turn off the entire system. |

***Note:*** *Instead of setting the whole house to one sleep time, you can set different sleep times for individual rooms by using the ROOM button to select each room and setting SLEEP.*

*When two or more rooms are linked, adjusting the SLEEP time affects all linked rooms (indicated by boxed letters).*

*Id.* at 43.

632. Further, and as evidenced below, for example, Bose Lifestyle explicitly allows for multiple zones and operation.

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## 7.0 User Interface Operation

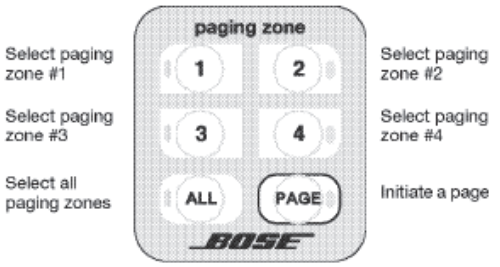
### 7.5 Multi-zone paging user interface operation

The Multi-zone paging user interface provides keys to select single paging zones, all paging zones and initiate a page.

Paging zones are not the same as output zones. After assigning the PAGE source to the output zones and choosing the appropriate settings in the Page Setup control pane, flashing the hardware maps the paging zone buttons accordingly.

When mapped, the paging zone **1** button will select the lowest numbered output ZONE to which the PAGE source is assigned. The paging zone **2** button will select the next lowest numbered output ZONE to which the PAGE source is assigned, and so forth.

**Multi-Zone Paging User Interface**

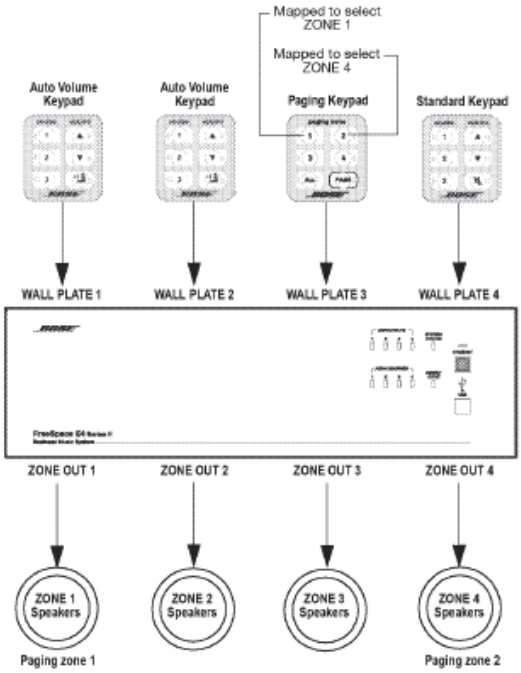



- Press **1**, **2**, **3** or **4** to select a paging zone. A green LED flashes to indicate that the zone is selected for paging. After ending a page the LED turns off.
- Press **ALL** to select all paging zones.
- Press **PAGE** to initiate a page in systems that do not use a PTT microphone.

**Paging User Interface Example:**

- The **PAGE** source is assigned to ZONE OUT 1 and ZONE OUT 4.
- In the Page Setup control pane for ZONE 1 and ZONE 4:

  **Paging Type** = Multi-zone
  **PAGE Control** = Wall plate 3
- After flashing the hardware, the paging zone **1** button selects ZONE OUT 1 for paging, and the paging zone **2** button selects ZONE OUT 4 for paging.



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## Figure 1: Two-Zone System

**Example System: Small Market**

The store is comprised of two zones, the main retail area and the cashier area. The main retail area receives music and paging, and operates at a fixed volume level.

The cashier area also receives music and paging, but its volume is controlled by the Auto Volume function and an Auto Volume wall plate.

| | | Zone 1 Retail | Zone 2 Cashier | Zone 3 | Zone 4 |
|---|---|---|---|---|---|
| Sources | | | | | |
| | Music | • | • | | |
| | Paging | • | • | | |
| Controls | | | | | |
| | Standard Wallplate | • | | | |
| | Auto Volume Wallplate | | • | | |

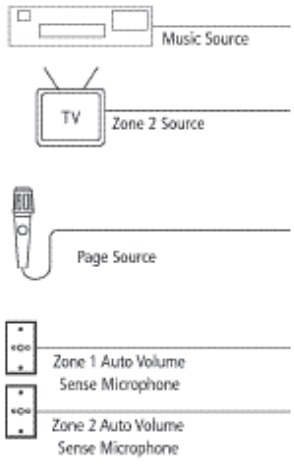
## Figure 2: Four-Zone System

**Example System: Restaurant**

The restaurant is comprised of four zones: dining, bar, patio, and the restrooms and lobby. All zones receive the music source, and the bar and lobby area receive paging. The bar area also can select the television audio source.

The dining and bar areas' volume is controlled by the Auto Volume function. The remaining zones, the patio and restrooms/lobby, are controlled using standard wall plate controls. A multi-zone paging interface is connected to the wall plate number four connection to provide independent paging of the two page zones.

| | | Zone 1 Dining | Zone 2 Bar | Zone 3 Patio | Zone 4 Entry/Restrooms |
|---|---|---|---|---|---|
| Sources | | | | | |
| | Music | • | • | • | • |
| | TV | | • | | |
| | Paging | | • | | • |
| Controls | | | | | |
| | Standard Wallplate | | | • | • |
| | Auto Volume Wallplate | • | • | | |




5 OF 8

Information subject to change without notice.

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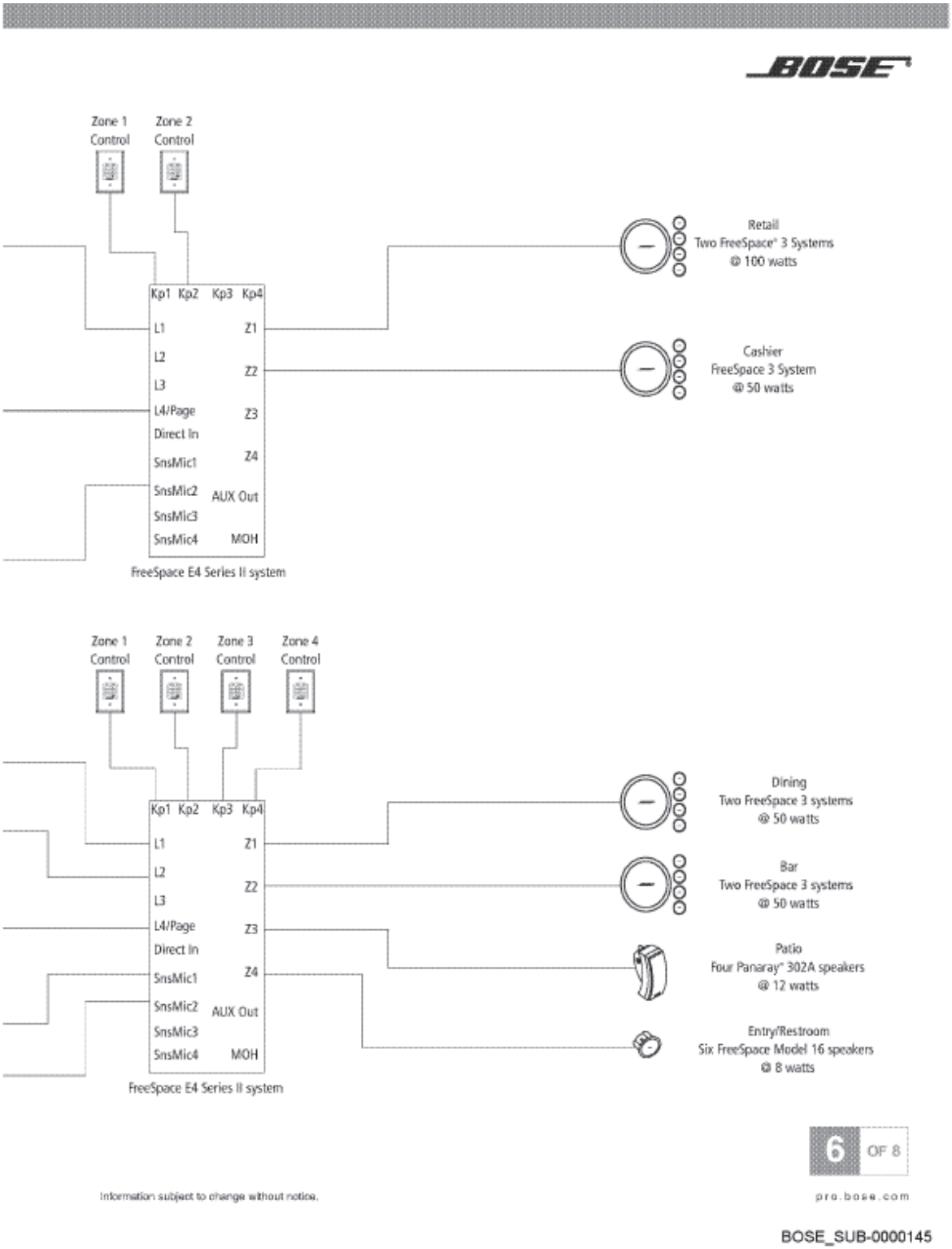


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633. Bose LifeStyle also allows for playing in multiple rooms.

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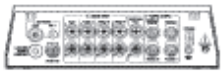
English

## Multi-room interface setup

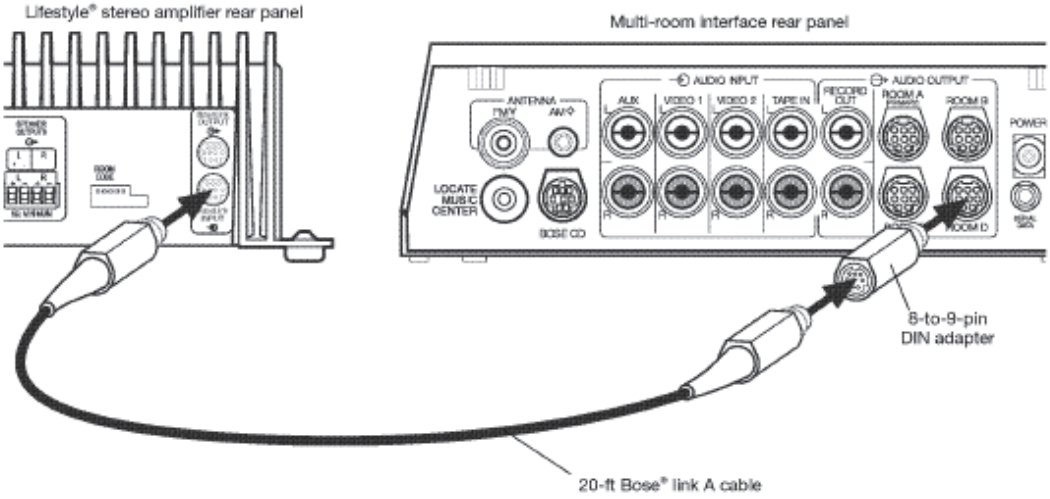
⚠ **CAUTION:** *Before making any connections, turn the Lifestyle® system off and disconnect the music center from the AC (mains) power outlet. DO NOT plug the amplifier into an outlet until you have completed all other connections.*



1. Insert the 8-to-9-pin adapter into one of the unused ROOM output connectors (B, C, or D) on the rear of the multi-room interface (Figure 10).
2. Insert one end of the Bose® link A cable into the 8-to-9-pin adapter.
3. Insert the other end of the Bose® link A cable, into the Bose® link input connector on the rear panel of the Lifestyle® stereo amplifier.

***Figure 10***

*Lifestyle® stereo amplifier to multi-room interface connections*





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### Setting up the Personal® music center

Systems that have a multi-room interface are controlled by the Personal® music center which requires no internal switch settings before it allows you to control more than one room of speakers. However, if you purchase a second Personal® music center, you must follow the procedure for setting up the Personal® music center for the first time.

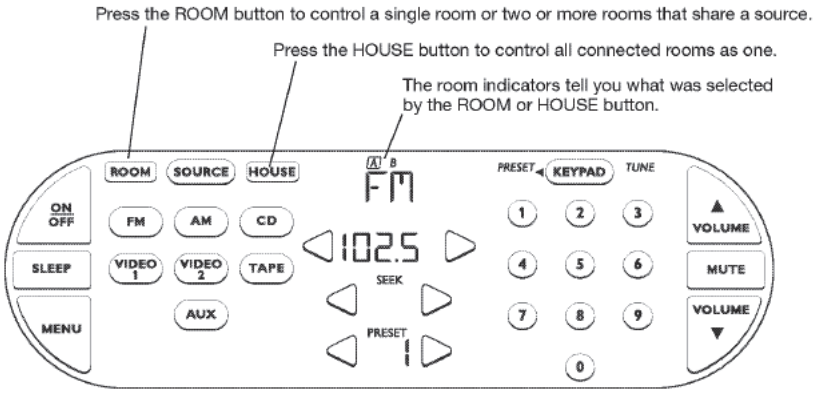
**Note:** *Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.*

### Selecting other rooms with the Personal® music center

The Personal® music center allows you to control up to four sets of Bose® powered speakers placed in individual rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal® music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 11 shows a sample display for a two-room system.

**Figure 11**

*Sample display for a two-room system*

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### Setting up the RC-20 remote for Zone 2

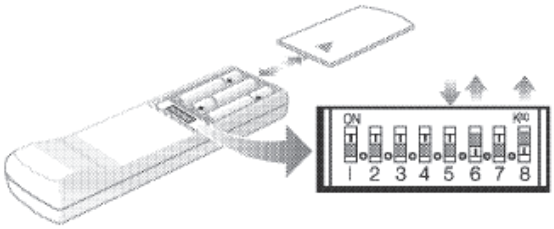
If your system uses a Model 20 music center, you need to set up a second RC-20 remote control to operate the ZONE 2 outputs.

1. Remove the remote control battery cover and locate the miniature switches (Figure 13).
2. Make sure that the house code settings (switches 1, 2, 3, and 4) match those in your first remote.
3. Slide switch 5 down (off), and switches 6 and 8 up (on).

**Note:** *Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.*

**Figure 13**

*RC-20 remote Zone 2 switch settings*





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634. Bose Lifestyle provide instructions for setting up additional rooms.

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English

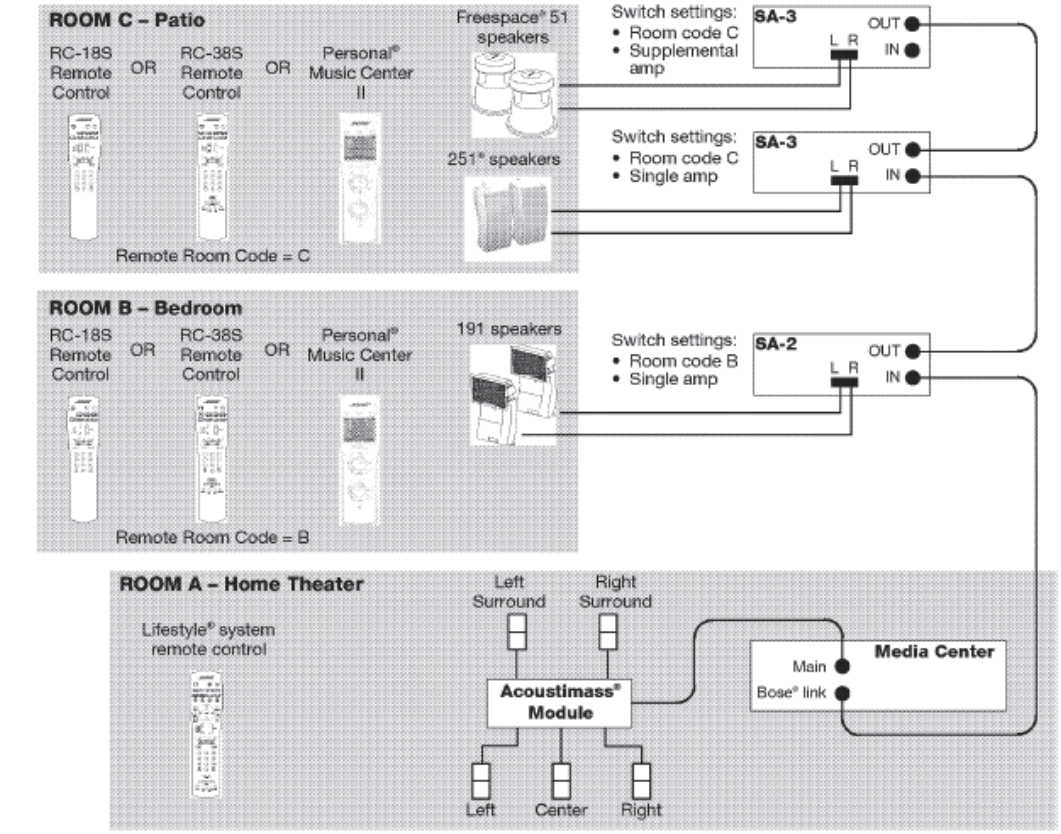
## Setup guidelines for additional rooms

If you have a Lifestyle® 18 series II, 28 series II, 38 or 48 home entertainment system, you can experience stereo sound in up to 14 other rooms using Lifestyle® stereo amplifiers, compatible speaker systems and remote controls for the other rooms.

- Remote controls for other rooms must be set to the same house code as the main room remote, but each remote must be set to a different room code. See "Setting up remote controls for other rooms" on page 23.
- The Lifestyle® amplifier and its remote control must be set to the same room code. See "Setting up the amplifier room code" on page 24.
- When using more than one amplifier to power more than two speakers in a room (Figure 18, room C), all amplifiers must be set to the same room code. Also, one amplifier must be set to the single amp mode and all others must be set to the supplemental amp mode. See "Single and supplemental amplifiers" on page 25.

**Figure 18**

*Sample installation of Lifestyle® stereo amplifiers*



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## Setting up remote controls for other rooms

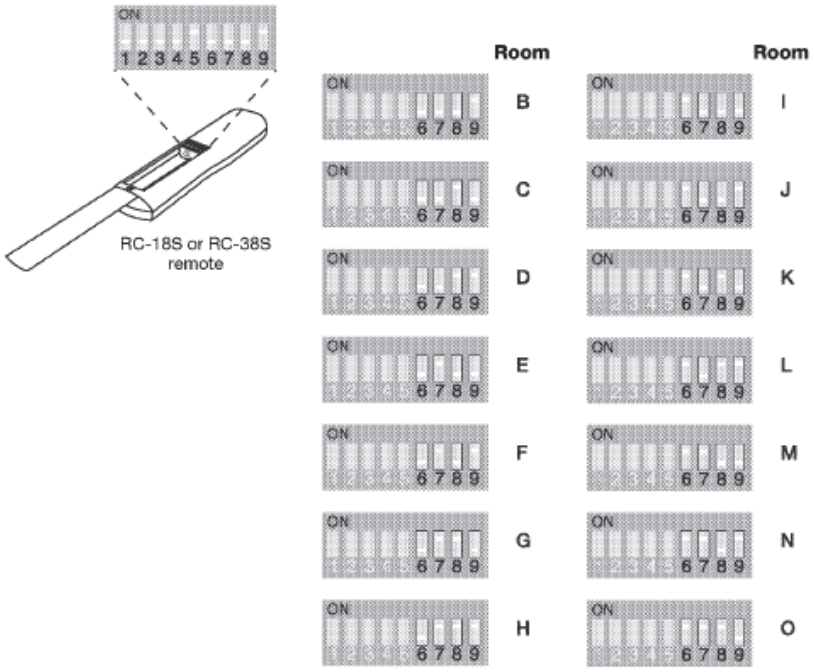
***To set up the RC-18S or RC-38S remote:***

1. Remove the remote control battery cover and locate the microswitches (Figure 19).
2. Make sure that the house code settings (switches 1, 2, 3, and 4) match the house code settings in your main room remote.
3. This remote is shipped from the factory set for room B. If this remote is used beyond a second room, set switches 6, 7, 8, and 9 to the same room code as set in the Lifestyle® stereo amplifier.

♪ ***Note:*** *Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.*

***Figure 19***

*Microswitch settings for RC-18S and RC-38S remotes*




***To set up the Personal® music center II:***

Refer to the owner's guide included with the Personal® music center II for instructions on configuring this remote for other rooms.





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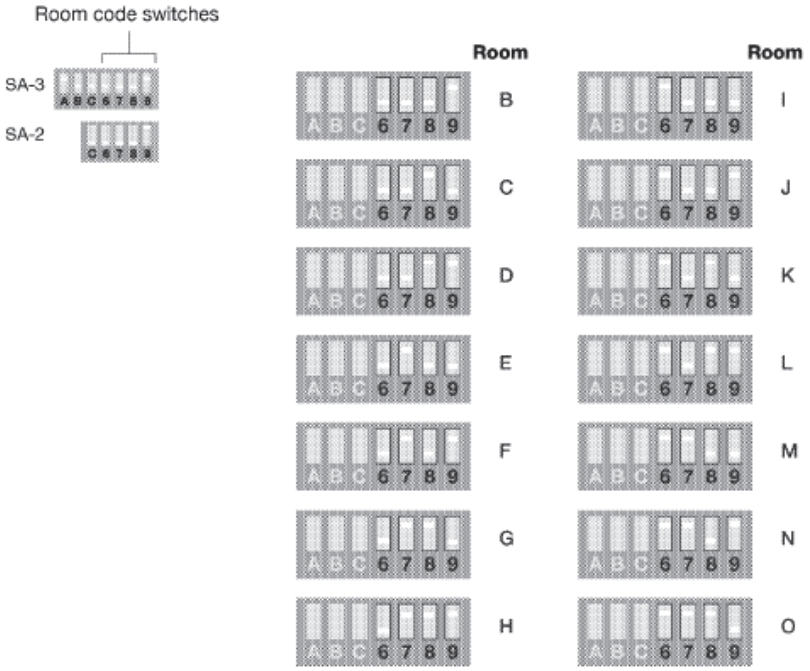
English

### Setting up the amplifier room code

The room code of the amplifier must match the room code of the remote used in the room where the speakers are installed.

***Figure 20***

*Amplifier room code settings*





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635. Bose Lifestyle specifically teaches a "Bose Link" that is a communication protocol

that allows for the playing of audio in multiple room or multiple zones.

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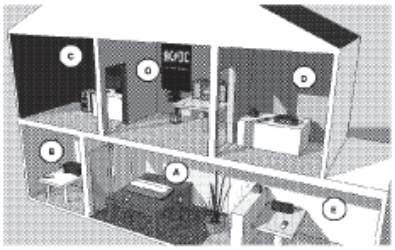
## What is Bose Link?

Bose link is a communication protocol. To communicate there must be at least two participants that speak the same language. To Bose products, Bose link is that language.

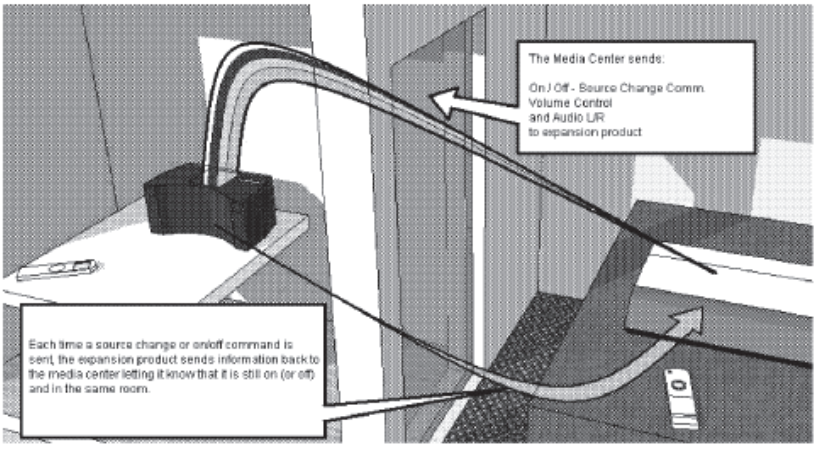
## Rooms

There are 15 different rooms that can be controlled by a Bose link enabled media center. The main room – labeled room A – is reserved for the Lifestyle speaker components. The other rooms – rooms B-O – are reserved for expansion via Bose link.



For a Bose link setup to work the system must include a Bose link enabled media center (a controller), a Bose link expansion product, and an expansion remote control. Both the expansion product and the remote must be configured to operate on the same room.

A Bose link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the expansion product. The expansion product responds by sending information back to the media center to let it know that it is still on (or off) and in the same room. This information exchange occurs each time a power or source change command is issued by the expansion remote.




When the media center receives an ON command from an expansion remote the system turns on and checks for any Bose link products that might be connected, but it will only look for Bose link products that are assigned to the same room as the remote.

Understanding Bose® link Page 2 of 8

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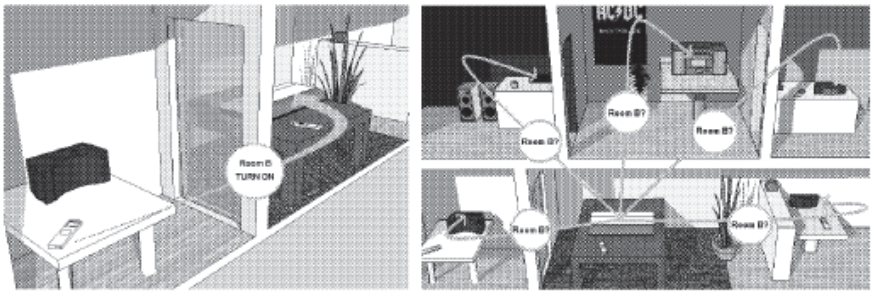
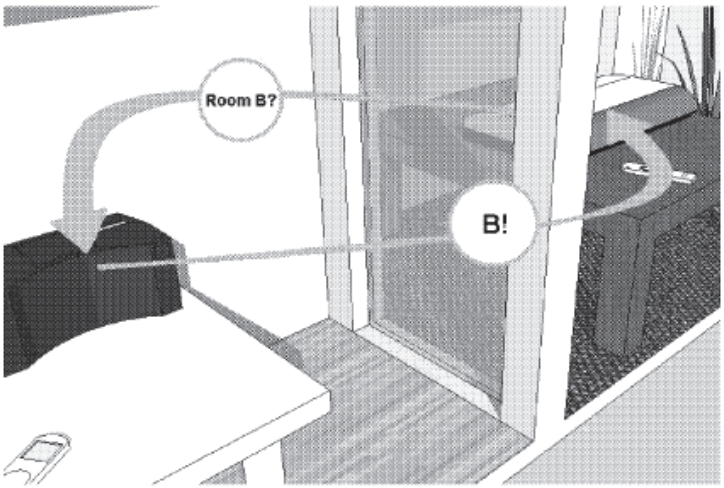
If the media center receives a command from a remote configured for room B, for example, the media center calls out to other Bose link products which might be assigned to room B. If a connected expansion product is assigned to room B it will respond to the media center and a Bose link connection will be made. The media center will not acknowledge a response from anything not assigned to room B.






The media center will not acknowledge more than one response from the same room, either. As with any productive conversation, there can only be one person speaking at a time. If more than one product is assigned to room B the media center won't know which one to listen to. If the media center can't understand the response from the expansion products, or if there is no response at all, the media center will turn itself off and the Bose link connection will not be successful.

Understanding Bose® link Page 3 of 8

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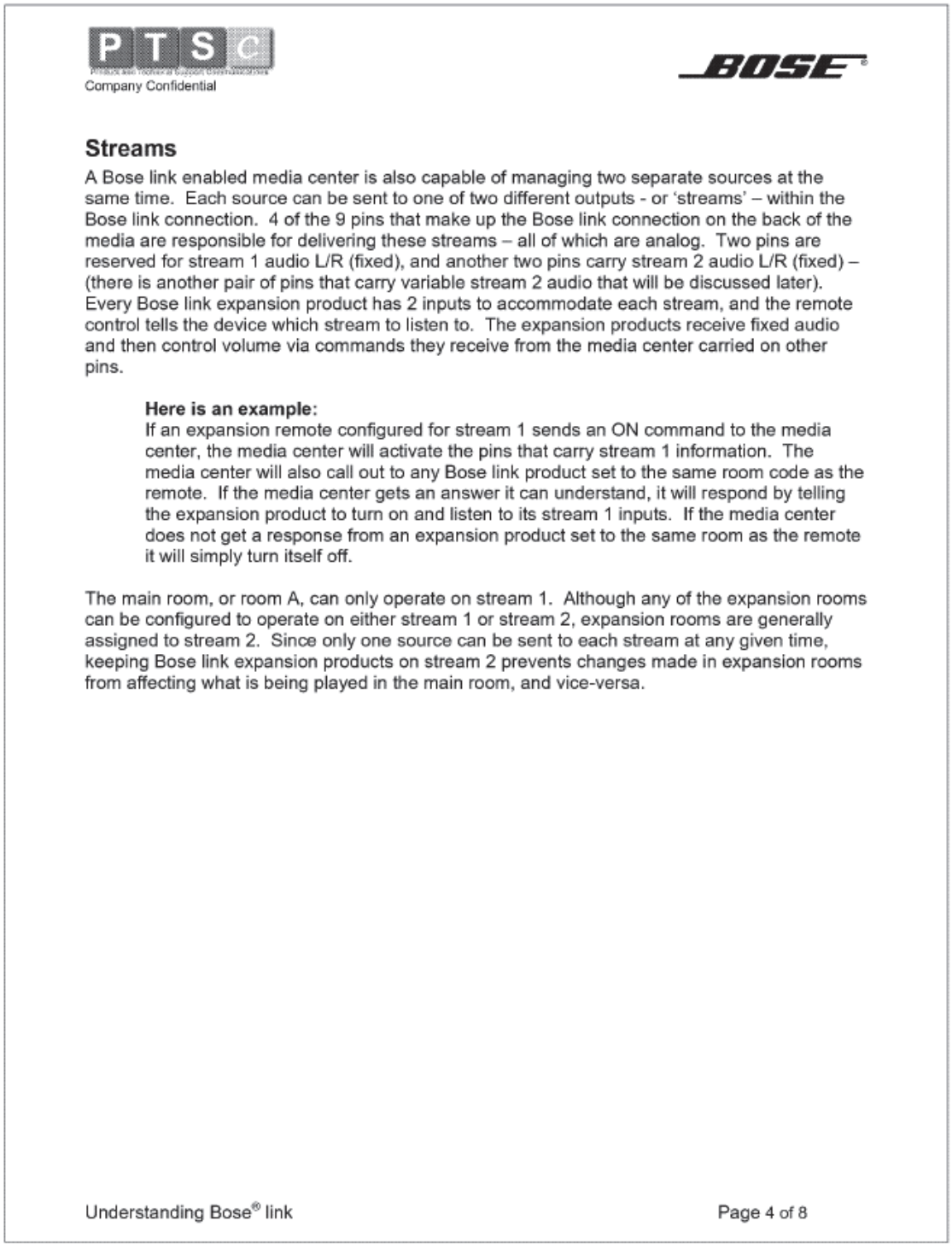

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## Streams

A Bose link enabled media center is also capable of managing two separate sources at the same time. Each source can be sent to one of two different outputs - or 'streams' – within the Bose link connection. 4 of the 9 pins that make up the Bose link connection on the back of the media are responsible for delivering these streams – all of which are analog. Two pins are reserved for stream 1 audio L/R (fixed), and another two pins carry stream 2 audio L/R (fixed) – (there is another pair of pins that carry variable stream 2 audio that will be discussed later). Every Bose link expansion product has 2 inputs to accommodate each stream, and the remote control tells the device which stream to listen to. The expansion products receive fixed audio and then control volume via commands they receive from the media center carried on other pins.

**Here is an example:**
If an expansion remote configured for stream 1 sends an ON command to the media center, the media center will activate the pins that carry stream 1 information. The media center will also call out to any Bose link product set to the same room code as the remote. If the media center gets an answer it can understand, it will respond by telling the expansion product to turn on and listen to its stream 1 inputs. If the media center does not get a response from an expansion product set to the same room as the remote it will simply turn itself off.

The main room, or room A, can only operate on stream 1. Although any of the expansion rooms can be configured to operate on either stream 1 or stream 2, expansion rooms are generally assigned to stream 2. Since only one source can be sent to each stream at any given time, keeping Bose link expansion products on stream 2 prevents changes made in expansion rooms from affecting what is being played in the main room, and vice-versa.

Understanding Bose® link Page 4 of 8

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636. I understand that Sonos does not meaningfully dispute that Bose Lifestyle discloses

this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Bose LifeStyle. I have reviewed Sonos's response ("Validity Contentions") as it relates to Bose LifeStyle and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 89.

*(iii) Limitation 1.2: "one or more processors;"*

637. In my opinion, Bose LifeStyle discloses this claim limitation. For example, Bose LifeStyle utilizes Jewel Cube speakers, and the multi-room interface, with four independent audio outputs allow you to enjoy Bose sound throughout one's home.

> Thank you for purchasing the Bose® Lifestyle® 50 system. Years of research lie behind this complete audio home entertainment system – the most advanced home theater system from Bose. Technological innovations that make the Lifestyle® 50 system unique include the Bose Personal™ music center, which places all system operations in the palm of your hand, and tiny Jewel Cube® speakers.
>
> The interactive Personal music center is a clear departure from convention, communicating with the system through a two-way radio data link. The result for you is full control of this entertainment system as you move about your home.

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> The other elements of the Lifestyle® 50 system are designed to be hidden from view:
>
> - The elegant Lifestyle® CD changer, designed to give you flexibility in where it is placed
> - The hideaway powered Acoustimass® module that delivers the rich, full, lifelike bass
> - The Bose multi-room interface, with four independent audio outputs that allow you to enjoy Bose sound throughout your home.

*Id.*

**Figure 1**

*What comes with your Lifestyle® 50 system:*

- Personal music center
- CD changer
- Multi-room interface
- Interface power pack*
- 5 Jewel Cube® speakers
- 5 speaker cables
- Acoustimass module
- AC power (mains) cord*
- 14 self-adhesive rubber feet (4 for the module and 5 pairs for the Jewel Cube speakers)
- Audio input cable
- CD changer cable
- Stereo cable
- 4 AAA batteries
- FM antenna
- AM loop antenna
- AM antenna base
- CD magazine
- Lifestyle® system CD
- Test CD

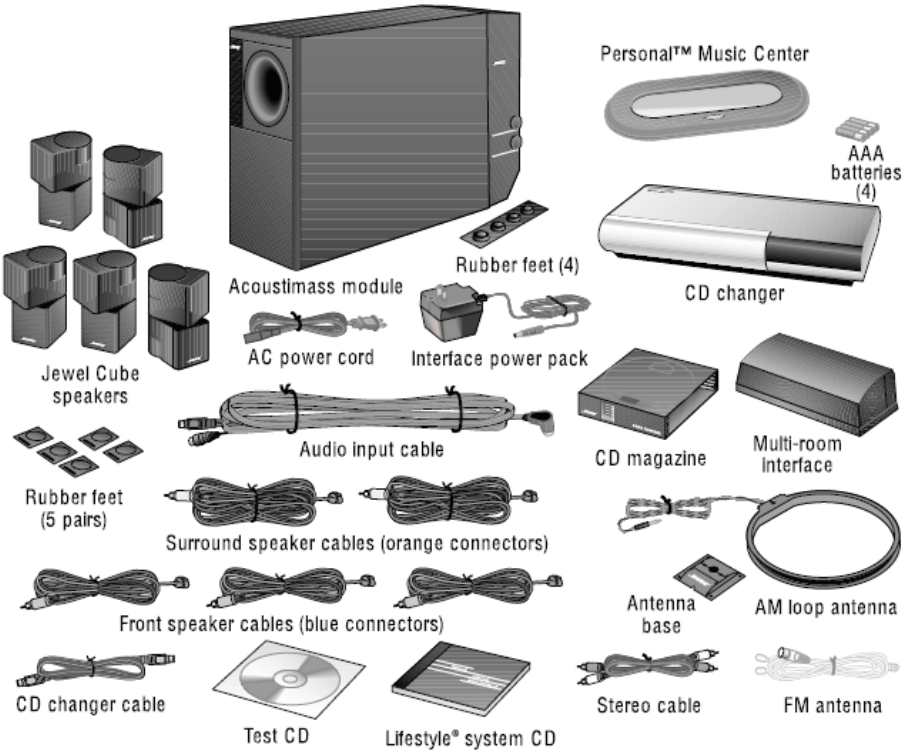
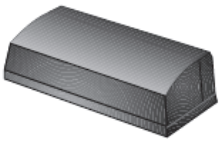



**Figure 5**

*The multi-room interface*



**Multi-room interface**

Select a location for the multi-room interface. It may be placed out of sight if you like.

1. Place the multi-room interface within 30 feet (9.1 m) of the Acoustimass module (the length of the audio input cable).
2. Place the multi-room interface close enough to the sound sources (TV, VCR, DVD, etc.) to allow for cable length. If you need additional audio and/or video cables to connect all of your components, see your dealer or call Bose® Customer Service.

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638. Beyond that, internal Bose presentations and circuit diagrams show various hardware circuitry, including DSPs.

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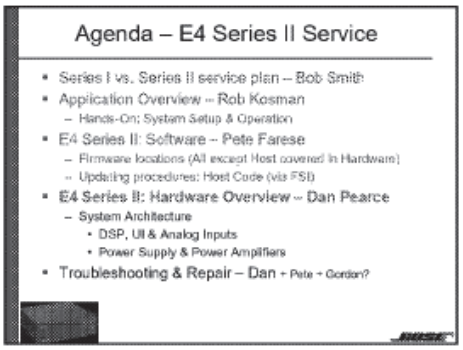
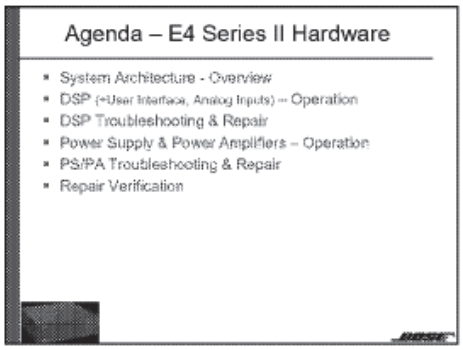
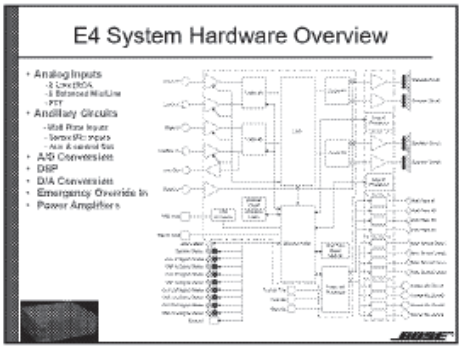
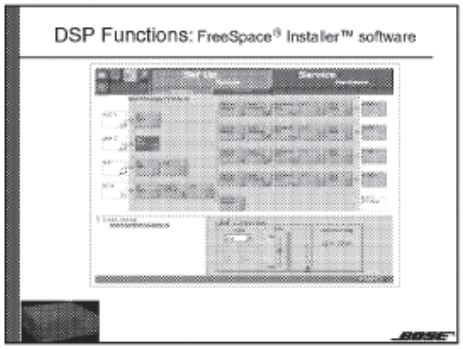
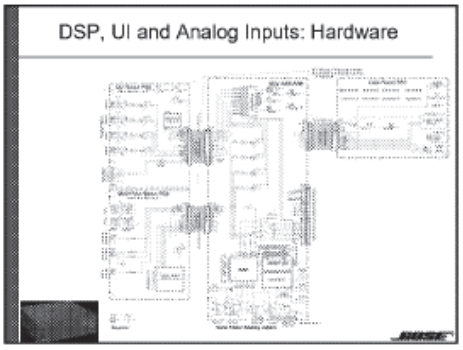
**FreeSpace® E4 Series II Service & Repair Training** 11/28/2004 3:12 PM

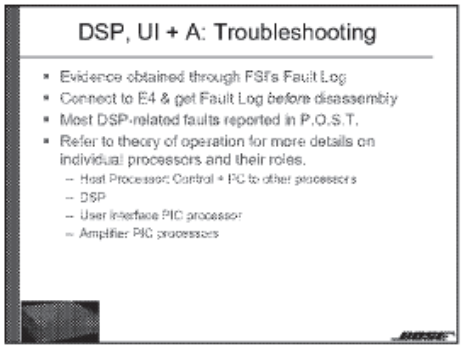



Hardware Section Page 1

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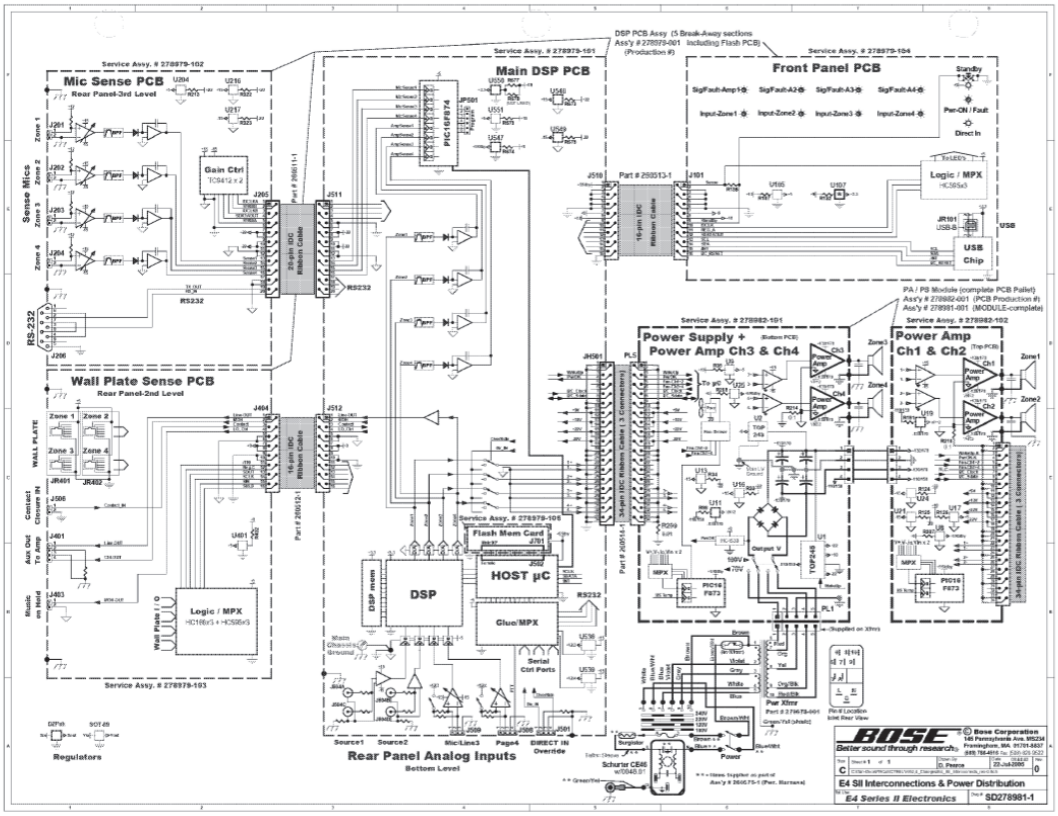


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639. I understand that Sonos does not meaningfully dispute that Bose LifeStyle discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Bose Lifestyle. I have reviewed Sonos's response ("Validity Contentions") as it relates to Bose LifeStyle and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 89.

*(iv) Limitation 1.3: "a non-transitory computer-readable medium; and"*

640. In my opinion, the Bose LifeStyle discloses this claim limitation. For example, the Bose LifeStyle stores on a non-transitory computer-readable medium firmware that it executes. The Bose LifeStyle also automatically monitors and adjusts the volume to let users hear soft

sounds, and prevents a user from being overwhelmed.

**Automatic sound level monitoring and control**

Your enjoyment of movies is enhanced by Digital Dynamic Range® compression. This technology automatically monitors and adjusts the volume to let you to hear soft sounds, particularly dialogue, but prevents you from being overwhelmed by loud special effects. This is especially useful for late night viewing – it eliminates the need to constantly adjust the volume.

*Id.* at 4.

When you place your speakers according to the guidelines below, a combination of reflected and direct sound provides the audio atmosphere of a home theater. You may experiment with the placement and orientation of the Jewel Cube® speakers and Acoustimass® module to produce the sound most pleasing to you. For more discussion of speaker placement and room acoustics, see "Fine-tuning your system" on page 36.

*Id.* at 6.

641. I understand that Sonos does not dispute that Bose LifeStyle discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Bose LifeStyle . I have reviewed Sonos's response ("Validity Contentions") as it relates to Bose LifeStyle and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 90.

*(v) Limitation 1.4: "program instructions stored on the non-transitory computer-readable medium that, when executed by the one or more processors, cause the first zone player to perform functions comprising:"*

642. In my opinion, the Bose LifeStyle discloses this claim limitation. For the reasons stated above with respect to Limitations 1.2 and 1.3, Bose LifeStyle includes program instructions stored on the non-transitory medium that when executed by the processors perform the functions discussed in the following claim limitations, as described below. Bose LifeStyle may be

programmed and updated, and once programmed and/or updated, Bose LifeStyle may execute the instructions that are stored on the Bose LifeStyle.

643. I understand that Sonos does not dispute that Bose LifeStyle discloses this claim limitation. Specifically, I understand that Google served an interrogatory requesting Sonos's contentions for why Claim 1 of the '885 patent is not invalid over Bose LifeStyle . I have reviewed Sonos's response ("Validity Contentions") as it relates to Bose LifeStyle and Sonos does not dispute this claim limitation. *See* Validity Contentions (Attachment A to Sonos's Supp. Rsp. To Google's First Set of Rogs) at 90.

*(vi) Limitation 1.5: "while operating in a standalone mode in which the first zone player is configured to play back media individually in a networked media playback system comprising the first zone player and at least two other zone players:"*

644. In my opinion, Bose LifeStyle discloses this claim limitation.

645. For example, the Bose LifeStyle allows for automatic sound level monitoring and control.

**Automatic sound level monitoring and control**

Your enjoyment of movies is enhanced by Digital Dynamic Range® compression. This technology automatically monitors and adjusts the volume to let you to hear soft sounds, particularly dialogue, but prevents you from being overwhelmed by loud special effects. This is especially useful for late night viewing – it eliminates the need to constantly adjust the volume.

*Id.* at 4.

When you place your speakers according to the guidelines below, a combination of reflected and direct sound provides the audio atmosphere of a home theater. You may experiment with the placement and orientation of the Jewel Cube® speakers and Acoustimass® module to produce the sound most pleasing to you. For more discussion of speaker placement and room acoustics, see "Fine-tuning your system" on page 36.

*Id.* at 6.

646. Further, it is my opinion that Bose LifeStyle allows the ability to play audio through

multiple Jewel Cube speakers.

**Figure 1**

*What comes with your Lifestyle® 50 system:*

- Personal music center
- CD changer
- Multi-room interface
- Interface power pack*
- 5 Jewel Cube® speakers
- 5 speaker cables
- Acoustimass module
- AC power (mains) cord*
- 14 self-adhesive rubber feet (4 for the module and 5 pairs for the Jewel Cube speakers)
- Audio input cable
- CD changer cable
- Stereo cable
- 4 AAA batteries
- FM antenna
- AM loop antenna
- AM antenna base
- CD magazine
- Lifestyle® system CD
- Test CD

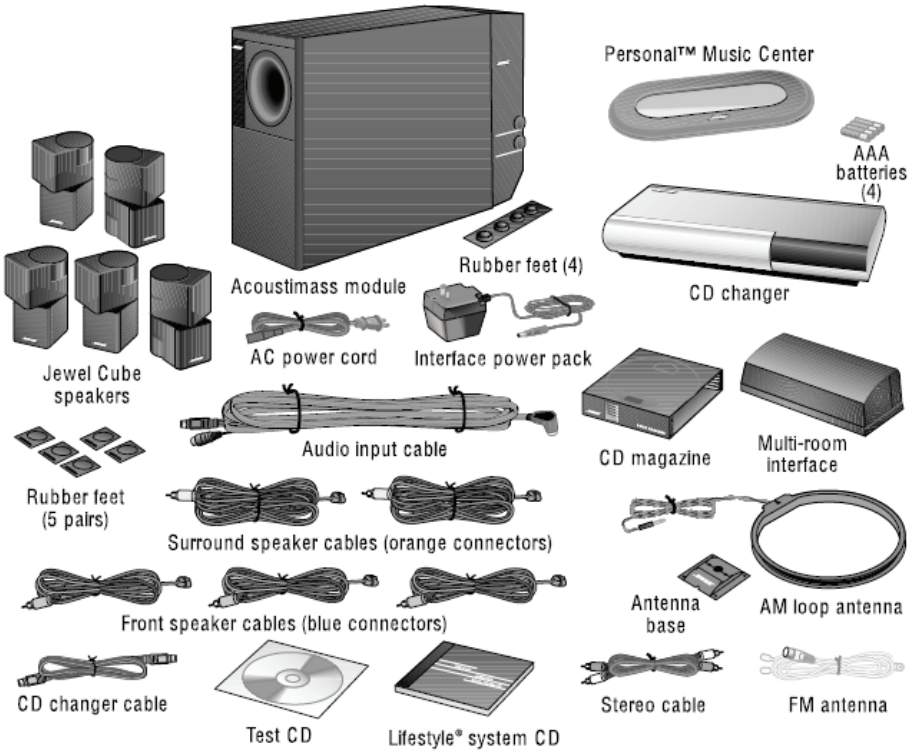


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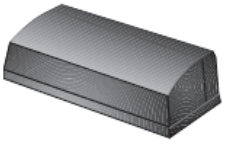
**Figure 5**

*The multi-room interface*



**Multi-room interface**

Select a location for the multi-room interface. It may be placed out of sight if you like.

1. Place the multi-room interface within 30 feet (9.1 m) of the Acoustimass module (the length of the audio input cable).
2. Place the multi-room interface close enough to the sound sources (TV, VCR, DVD, etc.) to allow for cable length. If you need additional audio and/or video cables to connect all of your components, see your dealer or call Bose® Customer Service.

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647. More specifically, Bose LifeStyle allows for connecting the Jewel Cube speakers to the Acoustimass module in order to control the Jewel Cube speakers.

### Connecting the Jewel Cube® speakers to the Acoustimass® module

1. Match each cable to the corresponding speaker location.
   - Front speaker cables have blue RCA connectors at one end, with L, R, or C molded into both the RCA connectors and the Jewel Cube connectors at the other end.
   - Surround speaker cables have orange RCA connectors at one end, with L or R molded into both the RCA connectors and the Jewel Cube connectors at the other end.
2. Insert the Jewel Cube connector of each cable fully into the jack on the rear of one of the five speakers (Figure 7). Match the ridge of the connector to the notch at the top of the jack.
3. Connect each cable to the corresponding jack on the Acoustimass module (Figure 8).
   - Plug the blue connectors into the matching left front, center, and right front jacks.
   - Plug the orange connectors into the matching left surround and right surround jacks.

To lengthen the cable, connect speaker wire with male phono (RCA) plugs on each end to your supplied speaker cable. Use a female-to-female adapter ("barrel" connector). Or, splice in 18-gauge (.75 mm²) or thicker cord (connecting + to + and – to –). To purchase extension wire, see your dealer or electronics store, or call Bose® Customer Service.

### Connecting the Acoustimass® module to the multi-room interface

Connect the module to the interface with the audio input cable (Figure 8).

1. Insert the right-angle multi-pin connector on the audio input cable into the AUDIO INPUT jack on the module. Align the connector at the angle shown in Figure 8.
2. Plug the small black multi-pin connector (flat side facing up) into the jack marked ROOM A (PRIMARY) on the back of the interface.

♪ ***Note:*** *The female RCA connector on the audio input cable is for connecting the digital output of a DVD player or other digital source to the system. See "Setting up a digital sound source" on page 12.*

♪ ***Note:*** *Be sure that each connector is inserted completely into each jack.*

For information on connecting multi-room systems, see "Connecting additional rooms" on page 40.

### Connecting the CD changer to the multi-room interface

Connect the CD changer to the interface with the CD changer cable (Figure 8).

1. Plug a blue multi-pin connector (flat side facing up) into the jack marked BOSE CD on the back of the interface.
2. Plug the other blue multi-pin connector (flat side facing left) into the jack marked BOSE CD on the back of the CD changer.

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648. Bose LifeStyle also allows a user to setup a personal music center, which further bolsters my opinion that this claim limitation is met.

## Setting up the Personal™ music center

Set up the Personal music center after the rest of the system is connected and plugged in.

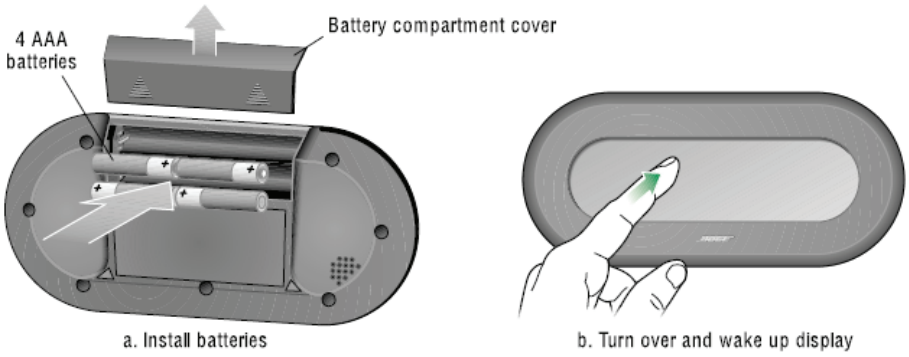
♪ ***Note:*** *When batteries are first installed in the music center, it sets up a radio-frequency link with the closest multi-room interface.*

1. Hold the music center within a few feet of the multi-room interface.
2. Slide open the battery compartment on the back of the music center (Figure 17).
3. Insert 4 AAA or IEC-R03 1.5V batteries, or the equivalent, as shown. Match the + and – symbols on the batteries with the + and – markings inside the compartment.
4. Slide the battery compartment cover back into place.
5. Turn the music center over and touch the screen to wake it up if it appears blank. Press ON/OFF, FM, or any other source button to turn the system on.

***If the music center continuously displays "NO RESPONSE,"*** you need to try to establish its link with the multi-room interface again. Hold the music center close to the multi-room interface. Press and hold MUTE for about 5 seconds until you hear a beep and then release. After about 10 seconds, the music center should beep twice to confirm that the link is established.

***Figure 17***

*Installing batteries and waking up the display for the first time*




♪ ***Note:*** *Replace the batteries when the LOW BATTERY message first appears. See "Replacing batteries" on page 44. Alkaline batteries are recommended.*

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## Turning on the system

You are ready to enjoy your new Lifestyle® system. Your Personal™ music center places complete control of the system operations in your hands. The center is portable, communicating with the rest of the system through a two-way radio-frequency link. The display is backlit for easy viewing, and provides visual feedback of current system operations and available options. To allow for maximum battery life, the display and backlight turn off a short time after your last button press. You only need to touch the screen to wake up the music center.

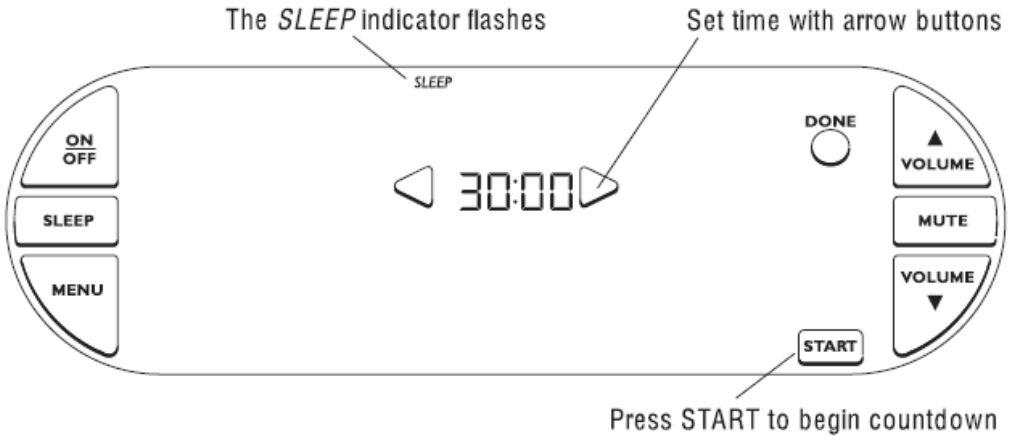
- To learn more about the display, see "Using the Personal music center display" on pages 20-21.
- To operate the AM/FM radio, see "Listening to the radio" on pages 26-28.
- To operate the CD changer, see "Listening to compact discs" on pages 29-34. To verify your system setup, listen to the instructions on the Test CD.
- To control external components, see "Using the system with external components" on page 35.
- To use your system in multiple rooms, see "Operating in more than one room" on pages 41-43.

*Id.* at 20.

### Using the sleep timer

- Press the SLEEP button to access the sleep timer for automatic shutoff. The display flashes a sleep time of 30 minutes or the most recent sleep time setting (Figure 20). The *SLEEP* indicator is also flashing.
- Use the arrow buttons to set the sleep timer to 1 to 99 minutes.
- Press the START button to start the counter. The START button disappears and a CLEAR button appears at the bottom of the display.

***Before pressing START ...***




*Id.* at 21.

649. Bose LifeStyle allows a user to setup audio playback for multiple rooms, while selecting other rooms using the Personal music center.

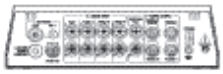
Contains Highly Confidential AEO and Source Code Materials



English

## Multi-room interface setup

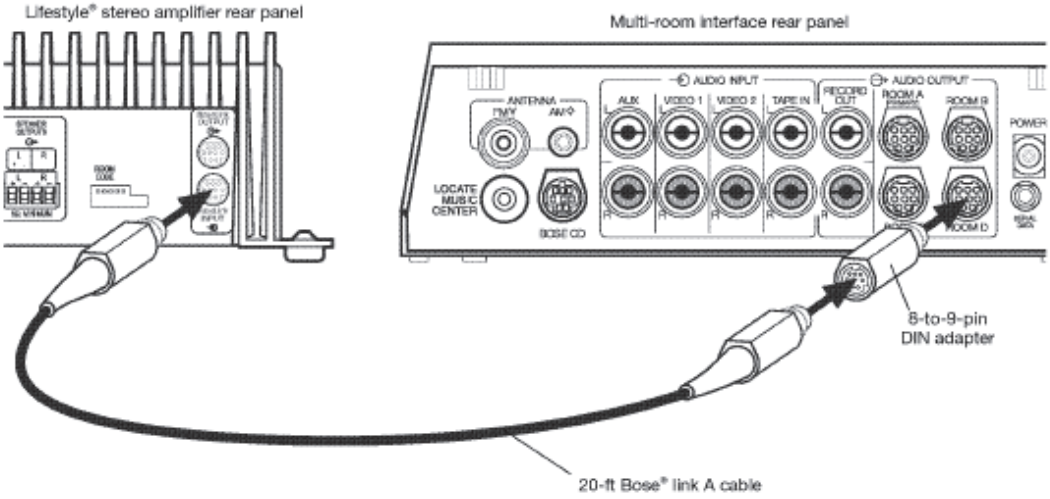
⚠ **CAUTION:** *Before making any connections, turn the Lifestyle® system off and disconnect the music center from the AC (mains) power outlet. DO NOT plug the amplifier into an outlet until you have completed all other connections.*



1. Insert the 8-to-9-pin adapter into one of the unused ROOM output connectors (B, C, or D) on the rear of the multi-room interface (Figure 10).
2. Insert one end of the Bose® link A cable into the 8-to-9-pin adapter.
3. Insert the other end of the Bose® link A cable, into the Bose® link input connector on the rear panel of the Lifestyle® stereo amplifier.

***Figure 10***

*Lifestyle® stereo amplifier to multi-room interface connections*



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(vii) *Limitation 1.6: "(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked; and"*

650. In my opinion, the Bose LifeStyle discloses this claim limitation.

651. Sonos discussed this claim limitation, in part, in its summary judgment briefing. As I discussed *supra* in Section X.A, Sonos argued that adding a speaker to a speaker group via a controller and sending an "indication" that need not include the "zone scene" or the players in that zone scene is sufficient to meet this claim element.

652. Bose Lifestyle discloses this behavior. As discussed above and further below, Bose LifeStyle allows for the addition of multiple rooms and zones to the be added to the Lifestyle ecosystem.

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English

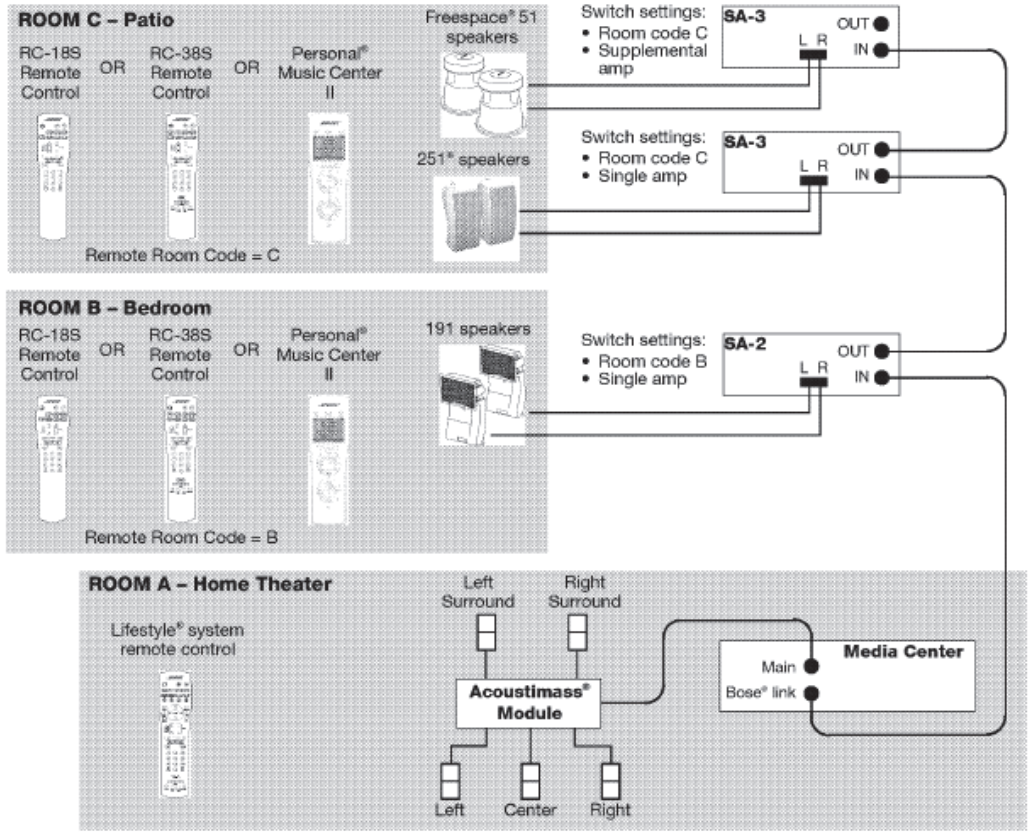
## Setup guidelines for additional rooms

If you have a Lifestyle® 18 series II, 28 series II, 38 or 48 home entertainment system, you can experience stereo sound in up to 14 other rooms using Lifestyle® stereo amplifiers, compatible speaker systems and remote controls for the other rooms.

- Remote controls for other rooms must be set to the same house code as the main room remote, but each remote must be set to a different room code. See "Setting up remote controls for other rooms" on page 23.
- The Lifestyle® amplifier and its remote control must be set to the same room code. See "Setting up the amplifier room code" on page 24.
- When using more than one amplifier to power more than two speakers in a room (Figure 18, room C), all amplifiers must be set to the same room code. Also, one amplifier must be set to the single amp mode and all others must be set to the supplemental amp mode. See "Single and supplemental amplifiers" on page 25.

**Figure 18**

*Sample installation of Lifestyle® stereo amplifiers*



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## Setting up remote controls for other rooms

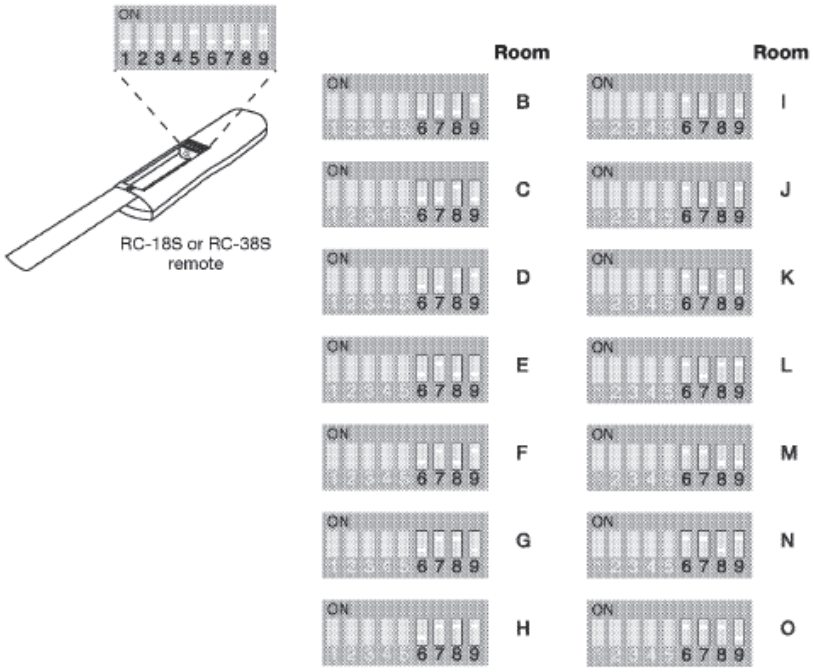
***To set up the RC-18S or RC-38S remote:***

1. Remove the remote control battery cover and locate the microswitches (Figure 19).
2. Make sure that the house code settings (switches 1, 2, 3, and 4) match the house code settings in your main room remote.
3. This remote is shipped from the factory set for room B. If this remote is used beyond a second room, set switches 6, 7, 8, and 9 to the same room code as set in the Lifestyle® stereo amplifier.

♪ ***Note:*** *Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.*

***Figure 19***

*Microswitch settings for RC-18S and RC-38S remotes*




***To set up the Personal® music center II:***

Refer to the owner's guide included with the Personal® music center II for instructions on configuring this remote for other rooms.





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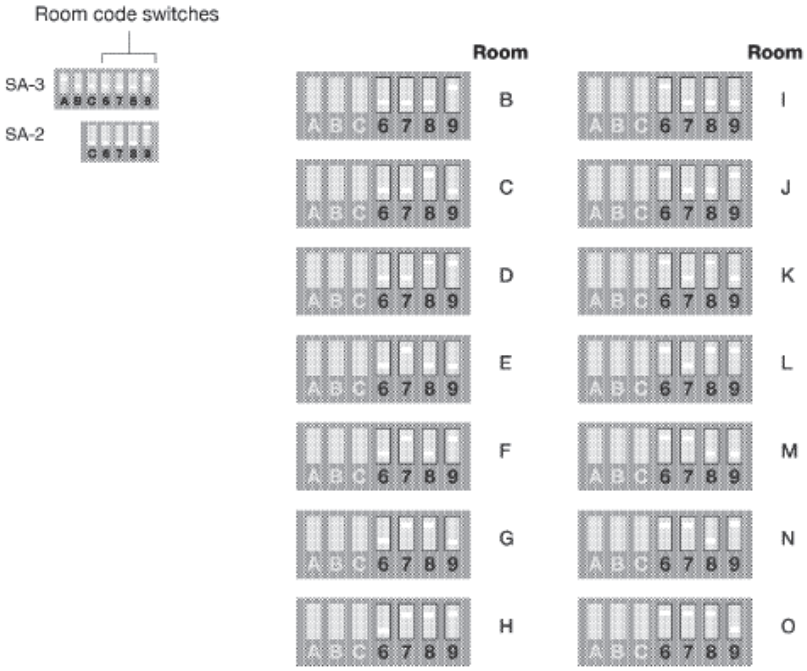
English

### Setting up the amplifier room code

The room code of the amplifier must match the room code of the remote used in the room where the speakers are installed.

***Figure 20***

*Amplifier room code settings*





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653. Then, as also mentioned before, the Bose Link communication protocol allows for

an indication that additional rooms, for example, have been added to the media center. The Bose Link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the zones. The zones then respond by sending information back to the media center to let it know that the zone is still active. Importantly, as described below, the media center will not acknowledge commands from any zone that is not targeted or invoked (BOSE_SUB-0000596).

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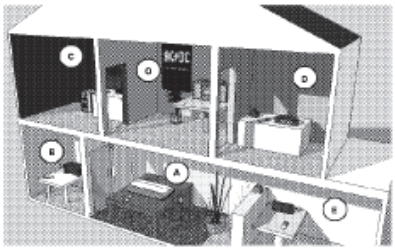
## What is Bose Link?

Bose link is a communication protocol. To communicate there must be at least two participants that speak the same language. To Bose products, Bose link is that language.

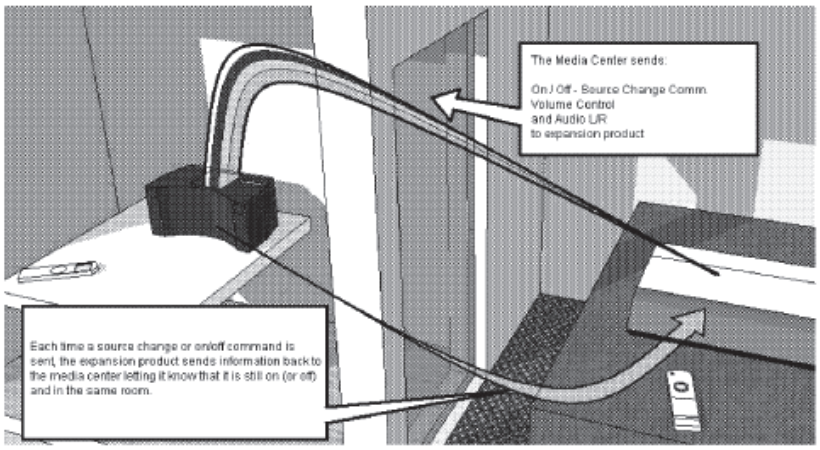
## Rooms

There are 15 different rooms that can be controlled by a Bose link enabled media center. The main room – labeled room A – is reserved for the Lifestyle speaker components. The other rooms – rooms B-O – are reserved for expansion via Bose link.



For a Bose link setup to work the system must include a Bose link enabled media center (a controller), a Bose link expansion product, and an expansion remote control. Both the expansion product and the remote must be configured to operate on the same room.

A Bose link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the expansion product. The expansion product responds by sending information back to the media center to let it know that it is still on (or off) and in the same room. This information exchange occurs each time a power or source change command is issued by the expansion remote.




When the media center receives an ON command from an expansion remote the system turns on and checks for any Bose link products that might be connected, but it will only look for Bose link products that are assigned to the same room as the remote.

Understanding Bose® link Page 2 of 8

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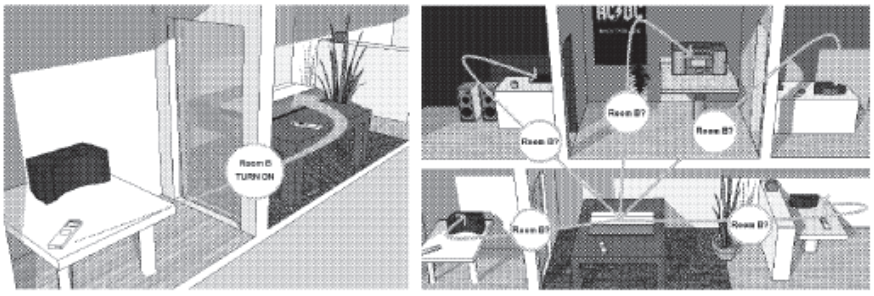
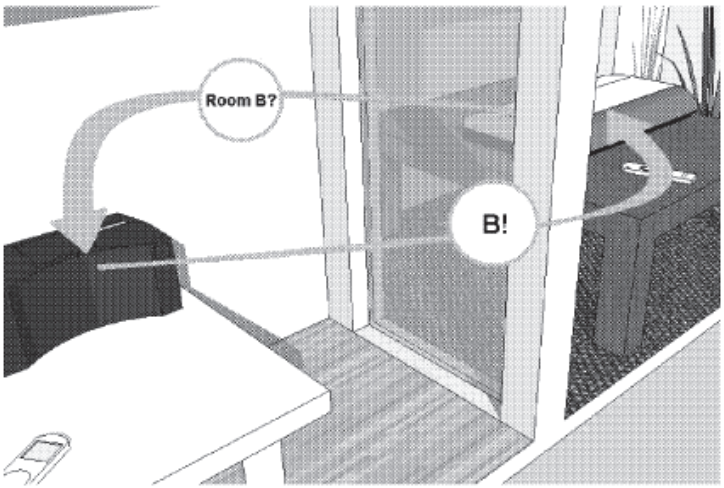
If the media center receives a command from a remote configured for room B, for example, the media center calls out to other Bose link products which might be assigned to room B. If a connected expansion product is assigned to room B it will respond to the media center and a Bose link connection will be made. The media center will not acknowledge a response from anything not assigned to room B.






The media center will not acknowledge more than one response from the same room, either. As with any productive conversation, there can only be one person speaking at a time. If more than one product is assigned to room B the media center won't know which one to listen to. If the media center can't understand the response from the expansion products, or if there is no response at all, the media center will turn itself off and the Bose link connection will not be successful.

Understanding Bose® link Page 3 of 8

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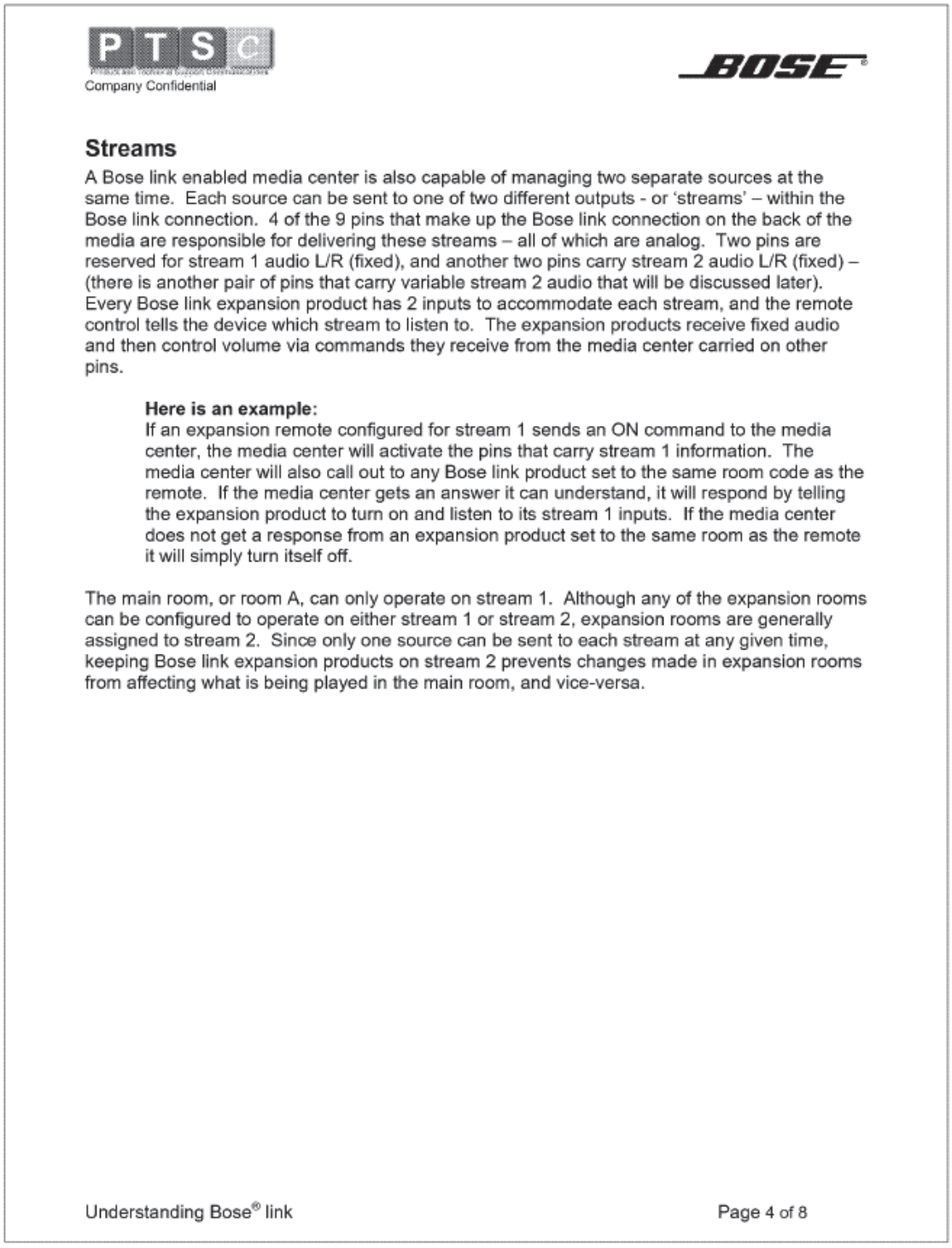
(viii) *Limitation 1.7: "(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player;"*

654. In my opinion, Bose Lifestyle discloses or renders obvious this claim limitation.

655. I incorporate by reference my discussion of limitation 1.6 herein, which discloses receiving from a network device an indication that the zone player has been added to a zone scene comprising a predefined grouping of zone players that are to be configured for synchronous playback of media when the zone scene is invoked. Limitation 1.7 adds the limitation that the first zone player is a member of two different "zone scenes."

656. In addition to the evidence disclosed in Limitation 1.7, the Bose Lifestyle expressly teaches managing two separate streaming sources at one time, such that room A can operate on stream 1, and room B can operate stream 2, for example.



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## Streams

A Bose link enabled media center is also capable of managing two separate sources at the same time. Each source can be sent to one of two different outputs - or 'streams' – within the Bose link connection. 4 of the 9 pins that make up the Bose link connection on the back of the media are responsible for delivering these streams – all of which are analog. Two pins are reserved for stream 1 audio L/R (fixed), and another two pins carry stream 2 audio L/R (fixed) – (there is another pair of pins that carry variable stream 2 audio that will be discussed later). Every Bose link expansion product has 2 inputs to accommodate each stream, and the remote control tells the device which stream to listen to. The expansion products receive fixed audio and then control volume via commands they receive from the media center carried on other pins.

**Here is an example:**
If an expansion remote configured for stream 1 sends an ON command to the media center, the media center will activate the pins that carry stream 1 information. The media center will also call out to any Bose link product set to the same room code as the remote. If the media center gets an answer it can understand, it will respond by telling the expansion product to turn on and listen to its stream 1 inputs. If the media center does not get a response from an expansion product set to the same room as the remote it will simply turn itself off.

The main room, or room A, can only operate on stream 1. Although any of the expansion rooms can be configured to operate on either stream 1 or stream 2, expansion rooms are generally assigned to stream 2. Since only one source can be sent to each stream at any given time, keeping Bose link expansion products on stream 2 prevents changes made in expansion rooms from affecting what is being played in the main room, and vice-versa.

Understanding Bose® link Page 4 of 8

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1) Obviousness – POSITA

657. In the alternative, this claim element discloses nothing more than overlapping speaker groups, which would have been obvious to a person of skill in the art at the time. Indeed, the Bose LifeStyle already disclosed having groups and dynamic reallocation of those groups, which indicates to a person of skill in the art that overlapping group membership is desirable, consistent with Sonos's arguments in its summary judgment briefing. A POSITA would have been motivated to add overlapping groups because Bose LifeStyle's own marketing materials touted the flexibility of its system to allow users to play back media throughout their household. *Supra*.

658. A person of skill in the art would have recognized that by allowing a user to create speaker groups, those groups may either (1) allow overlapping group membership or (2) not allow overlapping group membership. Given that allowing overlapping group membership may be attractive to certain users because there was a recognized "need for dynamic control of the audio players as a group," it would have been obvious to select allowing overlapping group membership when implementing speaker groups. '885 Patent at 1:30-34.

1) Obviousness – Nourse

659. A person of skill in the art would also have been motivated to combine the Bose LifeStyle with Nourse, which discloses a plurality of speakers, each of which has "a unique 16-bit address." Nourse, 3:57-58. "Each of the speakers also can be assigned up to four group identifiers." *Id*. at 3:58-59. The group identifier "allows specific speakers to be assigned to a group and receive the same signal." *Id*. at 3:61-63. Thus, any speaker "can be assigned to more than one group." *Id*. at 4:5. Nourse is analogous to the '885 patent because it is in the same field of endeavor, "controlling or manipulating a plurality of multimedia players in a multi-zone system." '885 Patent, 1:30-34. For example, Nourse, like the '885 patent, explains that it is directed to "a centralized speaker system that allows multiple speakers connected to a central amplifier speaker line to be monitored and controlled from a central location via a mater/slave protocol." Nourse at

Abstract. Nourse is also reasonably pertinent to the problem to be solved by the '885 patent, which is "dynamic control of the audio players as a group." For example, Nourse explains that speakers may be "addressed individually or as part of a group" by "receiving unique content specific, respectively, to the individual remote speaker address and group address" (*id*. at 2:35-39) where the group address or identifier "allows specific speakers to be assigned to a group and receive the same signal" and play back audio as a group (*id*. at 3:61-63). Nourse teaches additional means for improving the user experience by allowing a user to add a playback device to multiple groups. Nourse at 3:57-4:5. It would have been desirable to allow a user to have a particular zone player join multiple groups (e.g., the kitchen and patio could be grouped for outside entertainment, and the kitchen and living room could be grouped for inside entertainment). Having a speaker join multiple groups would increase the number of customized combinations a user could configure in their home, as the Bose LifeStyle recognizes as an important feature. Nourse is also analogous to the Bose LifeStyle system as both relate to digital speaker systems with dynamic grouping features.

1) Obviousness – Rajapakse (US 8,239,559)

660. A person of skill in the art would have found it obvious to combine Rajapakse with Bose LifeStyle. Rajapakse was cited by many Sonos patents regarding speaker grouping, including patents from the same family as the '885 Patent, indicating that persons of skill in the art recognized that Rajapakse was highly relevant to the claimed features. For example, Mr. Lambourne in prosecuting US 2013/0251174 disclosed Rajapakse as relevant prior art. 2014-04-17 Information Disclosure Statement. Rajapakse was also cited by the following patents—which are closely related to the '885 patent.

| | | |
|---|---|---|
| US20130251174A1 | Sonos, Inc. | Controlling and manipulating groupings in a multi-zone media system |
| US8788080B1 | Sonos, Inc. | Multi-channel pairing in a media system |
| US9226087B2 | Sonos, Inc. | Audio output balancing during synchronized playback |
| US9226073B2 | Sonos, Inc. | Audio output balancing during synchronized playback |

| | | |
|---|---|---|
| US9456279B1 | Google Inc. | Automatic control and grouping of media playback devices based on user detection |
| US9671997B2 | Sonos, Inc. | Zone grouping |
| US9729115B2 | Sonos, Inc. | Intelligently increasing the sound level of player |
| US10209948B2 | Sonos, Inc. | Device grouping |
| US10306364B2 | Sonos, Inc. | Audio processing adjustments for playback devices based on determined characteristics of audio content |
| US10331399B2 | Apple Inc. | Smart audio playback when connecting to an audio output system |
| US10356526B2 | Razer (Asia-Pacific) Pte. Ltd. | Computers, methods for controlling a computer, and computer-readable media |
| US10516718B2 | Google LLC | Platform for multiple device playout |
| US11265652B2 | Sonos, Inc. | Playback device pairing |

661. Rajapakse discloses this claim element.

662. For example, Rajapakse discloses dynamic playback among many speakers in groups. 13:41-45 ("There may be multiple streams of audio being sent to multiple media renderers 203 in multiple zones at the same time. . . As an example, a media renderer may be the front left channel when a movie is being played to a screen that is centered between it and the front right. This would be configured as default movie stream. This same media renderer may be configured also to be the back left channel when playing a default HiFi audio stream, where hi performance front media renderers are positioned elsewhere in the room.").

663. Rajapakse also discloses synchronized playback in speaker groups. 11:60-65 ("The rendition of each stream by a media renderer 203 (speaker) needs to be synchronized in time. This is enabled by the distribution server 204 working with the media renderer 203, using a stream protocol specific to the media renderers 203. This protocol includes the methods to time-synchronize rendition of the stream.").

664. Rajapakse discloses dynamic grouping and transitioning speakers among different groups. 3:65-67 ("If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.").

665. Rajapakse discloses that each player/speaker may be a part of multiple groups. 4:47-54 ("Each media renderer 203 is set up with a variety of properties including lists of acceptable zone identifications, acceptable zone manager identifications, acceptable zone 50 control point identifications, lists of acceptable stream identifications, rendition properties such as volume and role properties.").

666. Rajapakse discloses having many properties for players within a speaker group and therefore discloses "zone scenes." 4:53-67 ("One of these properties, the 'role' of a media renderer 203, can define what stream channel the media renderer 203 will 55 play back. Each audio data stream may include multiple channels, where each channel is defined as front left, center, front right, back left, back center, back right, subwoofer, etc. The media renderer 203 can be configured to accept one of the channels in the stream. If the stream does not contain the channel the media renderer 203 is configured for, it may be configured to play an alternate channel or not play anything. In addition to the channel type roles, a media renderer's role may include other 'roles.' A media renderer's role could be to play only deep base sounds, or to play only high pitch sounds in the media. As another example, a media renderer's role may be to provide special effects, such as echoes or background sounds. As a further example, a media renderer's role may be to play pre-recorded media segments at various points of the media stream. For example, a media renderer 203 may play pre-recorded media segments on initiation by a control point or zone manager, or based on sensing various states or conditions, such as powering up the media renderer, or detecting a sensor condition.").

667. Rajapakse discloses overlapping groups or zones, and therefore overlapping speakers within those zones. 5:61-67 ("A zone is a physical space that a number of media renderers belong to and within which the media renderers are physically located. Typically a zone is a listening space, a space where the audio from all the media renderers in the space can be heard.

For example, all media renderers within a single auditorium will be in the same zone. Zones may overlap and may include other zones.").

668. Rajapakse discloses that speakers may be a member of more than one group. 6:1-4 ("Each media renderer 203 is assigned to one or more zones. Zones are typically identified with a Zone Identifier (ZID).").

669. Rajapakse discloses dynamic zone and speaker management. 6:6-19 ("The zone manager 210 dynamically gathers and aggregates information on the media renderers 203 in its vicinity and makes this information available to other services. . . . In addition to gathering media renderer information, the zone manager 210 holds information specific to a zone, manages the media renderers 203 in the zone, and may provide additional services and actions, such as media renderer reservation to other services such as control points 201. . . . The zone control point 209 is an enhanced version of a standard control point 201. The enhancements allow the zone control point 209 to interact with the zone manager 210 to quickly gather information on sets of media renderers 203 in a zone and perform actions on the zone.").

670. Rajapakse discloses zone management that is dynamic. 12:51-59 ("Once a zone manager 210 registers a media renderer 203, the zone manager 210 may view and modify the media renderer's setup by interacting with a user directly or via a control point 201. This includes modifying the media renderer's zone list, default stream list, role, and properties such as volume.").

1) Obviousness – Millington

671. A person of skill in the art would have been motivated to combine Millington with the Bose LifeStyle because Mr. Millington worked on Sonos products that are in the same field of endeavor as the Bose LifeStyle, and therefore it would have been an obvious choice to look to for guidance about potential modifications to that system. Mr. Millington's patents also described aspects of the Sonos System or aspects related to how those systems practice group

synchronization and therefore a POSITA would have looked to Millington to understand the Sonos System or its competitors, like Bose LifeStyle. Millington was also assigned to Sonos and was filed in the same timeframe as the Sonos System was released.

672. Millington discloses this claim element.

673. Millington discloses standalone speakers and synchronous groups. Millington at 6 ("In the following, the term "synchrony group" will be used to refer to a set of one or more zone players that are to play the same audio program synchronously. Thus, in the above example, zone players 11(1) and 11(2) comprise one synchrony group, zone player 11(3) comprises a second synchrony group, zone players 11(4) and 11(5) comprise a third synchrony group, and zone player 11(6) comprises yet a fourth synchrony group. Thus, while zone players 11(1) and 11(2) are playing the same audio program, they will play the audio program synchronously."); *Id.* ("Similarly, while zone players 11(4) and 11(5) are playing the same audio program, they will play the audio program synchronously.").

674. Millington discloses using dynamic groups. Millington at 7 ("In the network audio system 10, the synchrony groups are not fixed. Users can enable them to be established and modified dynamically. Continuing with the above example, a user may enable the zone player 11(1) to begin providing playback of the audio program provided thereto by audio information source 14(1)(1), and subsequently enable zone player 11(2) to join the synchrony group. Similarly, a user may enable the zone player 11(5) to begin providing playback of the audio program provided thereto by audio information source 14(5)(2), and subsequently enable zone player 11(4) to join that synchrony group. In addition, a user may enable a zone player to leave a synchrony group and possibly join another synchrony group. For example, a user may enable the zone player 11(2) to leave the synchrony group with zone player 11(1), and join the synchrony group with zone player 11(6). As another possibility, the user may enable the zone player 11(1) to leave the synchrony

group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby."); __ ("The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device.").

Millington discloses overlapping speaker groups. Millington at 17 ("As noted above, there may be multiple synchrony groups in the network audio system 10, and further that, for example, a zone player 11(n) may operate both as a master device 21 or a slave device 22(g) in one synchrony group, and as the audio information channel device 23 providing audio and playback timing information and clock timing information for another synchrony group."); __ ("Indeed, it will be appreciated that the zone player that is utilized as the audio information channel device for synchrony group 20(2) may also be a zone player that is utilized as the master device 21(1) or a slave device 22(1)(1),..., 22(K)(1) in the synchrony group 20(1).").

*(ix) Limitation 1.8: "after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation;"*

675. In my opinion, Bose Lifestyle discloses this claim limitation.

676. For example, Bose LifeStyle discloses adding additional zones or rooms to the media center, and then programming each room to be a certain frequency. Put another way, Bose LifeStyle allows a user to add additional speakers to zones of the Bose media center, and if any particular speaker is offline when the connected to the zone, it will remain offline, until invoked for use.

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English

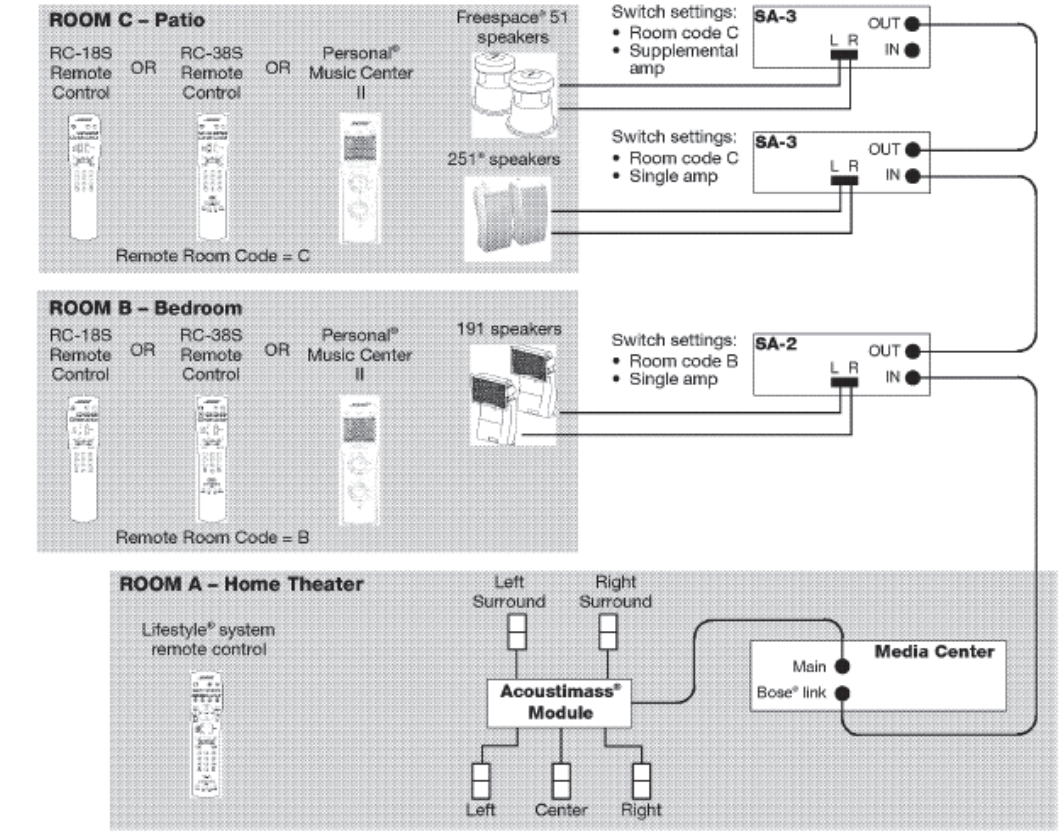
## Setup guidelines for additional rooms

If you have a Lifestyle® 18 series II, 28 series II, 38 or 48 home entertainment system, you can experience stereo sound in up to 14 other rooms using Lifestyle® stereo amplifiers, compatible speaker systems and remote controls for the other rooms.

- Remote controls for other rooms must be set to the same house code as the main room remote, but each remote must be set to a different room code. See "Setting up remote controls for other rooms" on page 23.
- The Lifestyle® amplifier and its remote control must be set to the same room code. See "Setting up the amplifier room code" on page 24.
- When using more than one amplifier to power more than two speakers in a room (Figure 18, room C), all amplifiers must be set to the same room code. Also, one amplifier must be set to the single amp mode and all others must be set to the supplemental amp mode. See "Single and supplemental amplifiers" on page 25.

**Figure 18**

*Sample installation of Lifestyle® stereo amplifiers*



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English

## Setting up remote controls for other rooms

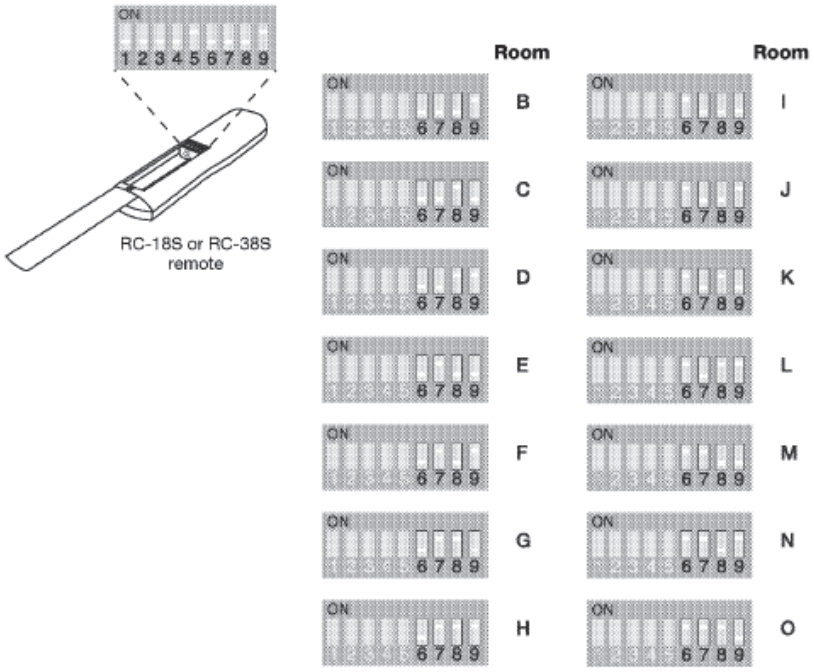
***To set up the RC-18S or RC-38S remote:***

1. Remove the remote control battery cover and locate the microswitches (Figure 19).
2. Make sure that the house code settings (switches 1, 2, 3, and 4) match the house code settings in your main room remote.
3. This remote is shipped from the factory set for room B. If this remote is used beyond a second room, set switches 6, 7, 8, and 9 to the same room code as set in the Lifestyle® stereo amplifier.

♪ ***Note:*** *Refer to your Lifestyle® system owner's guide for more information on operating your system in more than one room.*

***Figure 19***

*Microswitch settings for RC-18S and RC-38S remotes*




***To set up the Personal® music center II:***

Refer to the owner's guide included with the Personal® music center II for instructions on configuring this remote for other rooms.





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677. As previously mentioned, Bose LifeSytle allows a user to deliver music to

additional zones while simultaneously playing music in the main zone. Further, Bose Lifestyle's "room selector" enables a user to target specific zones with the ability to add additional zones to the media center, which will not be brought "online" until the selected by the user.

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# LIFESTYLE® SA-2 STEREO AMPLIFIER

## PRODUCT POSITIONING

- Our most popular Lifestyle® system expansion stereo amplifier.
- Enjoy Bose® sound throughout your home – from one Lifestyle® system. The Lifestyle® SA-2 stereo amplifier is designed for Lifestyle® system owners who want to enjoy Bose quality music in additional rooms of their home – indoors and outdoors – with their choice of Bose speakers.

## HEADLINES

*Expand your Lifestyle® system to additional rooms – easily and elegantly.*

Introducing the new Lifestyle® SA-2 stereo amplifier from Bose.

*Bring Bose® sound to other rooms in your home – from your Lifestyle® system.*

Introducing the new Lifestyle® SA-2 stereo amplifier from Bose.

*Enjoy Bose® sound here…and there…from your Lifestyle® system.*

Introducing the new Lifestyle® SA-2 stereo amplifier from Bose.

*Movies in one room. Music in up to 14 additional rooms. All from your Lifestyle® system.*

Introducing the new Lifestyle® SA-2 stereo amplifier from Bose.

## KEY PRODUCT BENEFITS (IN ORDER OF IMPORTANCE)

- **High-quality sound performance:** Bose patented signal processing circuitry enables full, rich stereo sound, even at low volumes.
- **Easy hookup:** Connects to Lifestyle® systems with a single Bose® expansion cable.
- **Easy, elegant placement:** Small footprint allows amplifier to easily be hidden in a room. Mounting flanges included for mounting to wall or floor joist.
- **Versatility, enabled by Bose® link:**
  - Enables choice between two independent audio streams from the Lifestyle® system (for example, a movie in one room, music in another).
  - Includes expansion output for "daisy-chaining" multiple Lifestyle® amplifiers for up to 14 additional rooms of audio.
  - Each amplifier can be controlled independently with a Lifestyle® expansion remote control (sold separately).

## KEY TECHNOLOGIES TO HIGHLIGHT (USE ICONS AS PROVIDED)

- **Bose® link:** A Bose proprietary networking technology that allows for easy, seamless expansion of your Lifestyle® system so you can enjoy different audio sources in different rooms, including outdoors. (*See Bose® link icon on "Technology Icons" page.)
- **Bose® patented signal processing circuitry:** Automatically adjusts tonal balance at different volume levels. Thus, music sounds lifelike with full, rich lows at almost any listening level, while speech consistently sounds natural.
- **Thermal compression circuitry:** Provides automatic protection for the amplifier electronics. If the amplifier approaches an unsafe operating temperature, the volume level is automatically lowered until a safe temperature is reached. Then, the volume is automatically returned to its original level.

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## LIFESTYLE® SA-2 STEREO AMPLIFIER

### ADDITIONAL PRODUCT INFORMATION

#### DETAILED PRODUCT INFORMATION

- Room selector switches assign the amplifier to a specific room and radio frequency remote control.
- Mini-DIN expansion input and output easily connects multiple Lifestyle® amplifiers to the Lifestyle® media center in a daisy chain, whenever two or more pairs of speakers are desired in a specific location (for example, outdoors or in a large hall).
- Wired Volume Control (VCA) input provides connection for an on-wall volume control (can be used with or in place of a Lifestyle® radio frequency remote control).
- Finned cast aluminum housing dissipates heat efficiently for lower operating temperatures, even at full output.
- Integrated mounting flanges allow for permanent mounting to walls or floor joists, if desired.
- Bose® expansion cable allows for a single connection of the amplifier to the Lifestyle® media center or multi-room interface.
- Dimensions: 4½"H x 14⅛"W x 5½"D (9 x 36 x 13.8 cm).
- Weight in carton: 7.6 lbs. (3.45 kg.).
- Power rating: Two-channel stereo operation, 40 watts (minimum) per channel.
- Speaker impedance: Compatible with speakers rated 6 ohms or higher.
- Color: Black.
- Limited one-year transferable warranty remains with the system even if ownership passes to another person.

#### OPTIONAL ACCESSORIES

- Lifestyle® radio frequency expansion remote controls (RC-18S for Lifestyle® 18 and 28 Series II systems, RC-38S and Personal® Music Center II for Lifestyle® 38 and 48 systems).

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678. That is, Bose Lifestyle allows additional zones to listen to what is being played in

the main room, or alternatively, something different. Alternatively, Bose LifeStyle allows the user the ability to add additional zones to the media center while audio is played in different zones. The newly added zones will remain offline until targeted or prompted by the user.

## LIFESTYLE® SA-2 STEREO AMPLIFIER

### SUGGESTED ADVERTISING SAMPLES

#### ADVERTISING COPY BLOCK

Attention Lifestyle® system owners: Did you know your Lifestyle® system can deliver music to other areas in your home – even while it's busy playing a DVD movie in the main room? Bose® link expansion capability makes it possible. And the Lifestyle® SA-2 stereo amplifier makes it easy. One simple connection of the SA-2 amplifier to the Bose® link output of your Lifestyle® system media center brings fresh musical possibilities to another room, including outdoors. Just add your choice of Bose stereo speakers. (Note: Lifestyle® SA-3 amplifier recommended for more powerful Bose speakers.) You can listen to what's playing in the main room…a CD, for example, or something different – perhaps your favorite FM station. Both at the same time, from one Lifestyle® system. So, the kids and their friends can keep on watching their movie while you enjoy some quality time – and quality Bose sound – out on the patio. And you can control your music from wherever you are with the dedicated radio frequency remote control. Bose patented signal processing circuitry automatically adjusts tonal balance for practically any volume level. The SA-2 amplifier is small enough to be easily hidden on the floor or on a shelf. You can even mount it to a wall or a floor joist. Get more out of your Lifestyle® system through Bose® link…and the SA-2 Lifestyle® stereo amplifier.

#### CATALOGUE COPY BLOCK

**Bose® Lifestyle® SA-2 Stereo Amplifier**
The most popular stereo amplifier from Bose works with your Lifestyle® system – and Bose® link – to bring music to a second room of your home, even outdoors. Simply connect the amplifier to the Bose® link output of your Lifestyle® media center with the included Bose® link cable, then connect your choice of Bose speakers to the amplifier. With the optional Lifestyle® expansion remote control you can choose the same musical program playing in the main room (a CD, for example) or something different (FM stereo). Compatible with Bose speakers rated 6 ohms or higher. Two-channel stereo operation, 40 watts (minimum) per channel. Size: 3½"H x 14¼"W x 5½"D. Color: Black.

#### SIMPLIFIED BULLETED FORMAT

Our most popular Lifestyle® system expansion stereo amplifier.

- Works with your Lifestyle® system and Bose® link to bring high-quality sound to other rooms in your home.
- Full, rich stereo sound, even at low volumes, from Bose® patented signal processing circuitry.
- Enables on-location choice between two independent audio streams from a Bose® link-enabled Lifestyle® system, with a Lifestyle® expansion remote control.
- Easy to hook up, easy to conceal.
- Room selector switches can assign multiple SA-2 amplifiers to specific rooms and specific Lifestyle® radio frequency remote controls.

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679. Indeed, as shown below, Bose LifeStyle allows for a user to control a single room

or two or more rooms that share a source (Room button), or to control all connected rooms as one (House button). Based on the room indicators, a boxed letter indicates the presently-selected room or rooms, and only these rooms will be affected by any sources changes. In my opinion, the implication is that when additional zones are added to the Bose LifeStyle media center, those additional zones will remain offline, until prompted by the user. At that time, as further described below, the Bose Link communication protocol is used to communicate with the newly added zone to bring it "online."

Contains Highly Confidential AEO and Source Code Materials

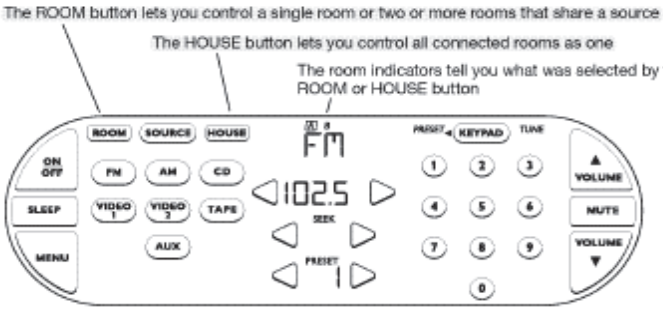


## Operating in more than one room

Your Lifestyle® 50 system can control up to four sets of Bose® powered speakers, allowing your family to enjoy different audio sources (CD, radio, TV, etc.) in up to four rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal™ music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 48 shows an example display for a two-room system.

**Figure 48**

*Example display for a two-room system*




### Understanding the room indicators

- [A] A boxed letter indicates the presently-selected room or rooms. The selected room is affected by any source changes, or any change you make using the VOLUME, MUTE, ON/OFF, or SLEEP buttons.
- B An unboxed letter indicates a room listening to a ***shared source***. A shared source is one that is playing in the controlled room as well as in up to three additional rooms. If you change the radio station, CD track, etc., of the shared source, the change affects all rooms sharing this source. However, you cannot change sources for all affected rooms at the same time. The VOLUME, MUTE, ON/OFF, and SLEEP buttons only affect the boxed room(s).
- [ ] An empty box appears for each connected room when you press the HOUSE button. When you change the volume in the HOUSE mode, the numerical level appearing on the display does not represent the actual volume level in all connected rooms. It only represents the actual volume in rooms represented by a boxed letter.





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### Using the HOUSE button

Using the HOUSE button, you can link all rooms together and control them as one. When you press the HOUSE button, an empty box indicator is displayed for each connected room. Any button pressed after that (any source button, VOLUME, MUTE, or SLEEP) affects every room. When you are done listening you can press OFF to turn off the entire system.

♪ **Note:** *If you do not press any additional buttons after pressing HOUSE, pressing HOUSE again cancels HOUSE mode.*

Press the HOUSE button before each command to apply that command to all rooms:

| Press ... | To do this ... |
|---|---|
| HOUSE then a source | Play the selected source in all connected rooms. |
| HOUSE then VOLUME ▲/▼ | Adjust the volume up or down by the same amount in all rooms that are on, or all connected rooms if they are all off. The system remembers the differences among the original room volume settings. |
| HOUSE then MUTE | Silence all connected rooms that are on, even if any were previously muted individually. To cancel this command, press HOUSE then MUTE again. Any rooms that were muted before this command was given stay silent until individually unmuted. If you unmute an individual room after it was muted by a HOUSE - MUTE command, the other rooms remain silent until each one is unmuted individually. Pressing HOUSE then VOLUME ▲unmutes all muted rooms. |
| HOUSE then SLEEP | Set the SLEEP timer for all rooms that are on. The SLEEP time selected applies to all rooms that are on even if they are playing different sources. If the SLEEP timer was already set in one or more rooms, the display shows the longest time already set. You can accept this time or change it for all the rooms. To cancel the HOUSE - SLEEP command, press HOUSE, SLEEP, CLEAR, and then DONE. |
| HOUSE then OFF | Turn off the entire system. |

♪ **Note:** *Instead of setting the whole house to one sleep time, you can set different sleep times for individual rooms by using the ROOM button to select each room and setting SLEEP.*

*When two or more rooms are linked, adjusting the SLEEP time affects all linked rooms (indicated by boxed letters).*

### Using more than one Personal™ music center

If you have a multi-room system, you can add additional music centers for some or all of the connected rooms. Each multi-room interface can be controlled by a maximum of four music centers. Each music center can control up to four rooms.

To add a new music center to your system, follow the setup instructions on page 17. Be sure to install the batteries and turn it on for the first time close to the multi-room interface to allow the new music center to set up a radio frequency link with your system. If the multi-room interface is not plugged in or the music center is out of range, the display indicates *NO RESPONSE*.





BOSE_SUB-00000045.

680.

1) Obviousness - POSITA

681. In the alternative, it would have been obvious to a person of skill in the art to allow

the Zone Players to remain in standalone mode as claimed. Indeed, the Sonos inventor wrote that there were only three possibilities for the behavior when a speaker is added to a group, as shown below in an excerpt from the provisional appendices in numbers 1-3.

**1.1.3 What happens to the Music that's already playing when a Zone Scene is started.**

If no music is playing in any Zone – then the zones will simply link in a group.

If music is playing in one or more zones there are several possibilities (TBD)

1. The Music Queue in the zone group that was formed by the Zone Scene will be empty. In other words – the music will stop in any room that is part of the Zone Scene. This is the simplest solution, but may lead to frustration.

2. The user gets to choose from which of the ;joining' Queues the new zone group should play. This could be in the form of a dialog:

**What should the new Zone Group play?**
No Music
Track 1
Track 2
Radio Station A

Note that this method would only be useful (and possible) with simple Zone Scene grouping. With Advanced Zone Scene groupings, this dialog would become much too complicated.

3. In the case where only one of the zones in the new group was playing music, the new group should take the music (and Queue) of that zone.

SONOS-SVG2—00167534 at 167537.

682. However, there are actually four possibilities for actions when a speaker is added to a group, not three, because none of the above are actually claimed, as I describe in Section XI. A person of skill in the art would have found it obvious to choose from one of these possibilities—stop music, choose music, adopt the music of the only playing speaker, and continue playing the "standalone" music—when adding a speaker to a group. These are a limited number of obvious design options.

1) Obviousness - Millington

683. Further, a person of skill in the art would have been motivated to combine Bose LifeStyle with Millington. They are both in the same field of endeavor—control of speaker systems, speaker groups, synchronous playback of speakers, and home audio systems—and they both describe the same features and devices (e.g., "zone players") in the same language. Further, a person of skill in the art looking to Bose LifeStyle would have also reviewed materials authored by one of the engineers, like Mr. Millington, that was working on the Sonos System to learn more about its capabilities given that Bose LifeStyle and Sonos were competitors.

February 07, 2005 | PLAYLIST

# Review: Sonos Digital Music System

## Innovative system's similarities to the iPod are more than skin deep.

*By Dan Frakes*

It used to be that listening to music at home happened mainly in one place—the room where all your CDs or, for us old-timers, LPs and cassettes were stored. A few houses had cheezy intercom-based speakers spread throughout the house, but these ugly wall consoles generally sat there, unused, a remnant of 1970s experiments in "cutting edge" technology. Upper-income-bracket audio geeks were able to install better whole-house audio systems, but these were rare.

That was then. Over the past few years, two technological trends have taken hold that promise to significantly change the face of home music listening. The first is the popularity of digital music. And by that I don't mean CDs, but rather the storage and playback of music data files: MP3s, AACs, AIFFs, WAVs, etc. More and more people are storing their entire music collection on computers, iPods, and other high-capacity media.

The second trend is the increasing pervasiveness of wireless data networks in the home. Nowadays, most people either have a wireless home network or know someone who does. It's safe to say that in the not-too-distant future, wireless home networks will be as common as wired telephones.

I bring up these two trends because of their inevitable convergence. It's only a matter of time before your average consumer realizes that if they have all their music stored in a format that can be sent over a wireless network, they should be able to listen to *any* of their music *anywhere* in their home at *any* time.

Several companies have attempted to bring this convergence to the masses, including Apple via its AirPort Express with AirTunes, Slim Devices with its Squeezebox, and Roku with its SoundBridge units. But each of these systems has significant flaws—an AirPort Express system can only play to a single room and has no screen; the Roku units can't sync across multiple rooms; and the Squeezebox, which probably does the most right, still doesn't make it easy to navigate large music collections. The market is ripe for a product that does the whole-house-music thing right.

IA at 202.

## How much is it gonna cost me?

Alas, all this technology isn't cheap. ZonePlayers retail for $499 each, with Controllers at $399 each; a "starter" set of two ZonePlayers and a single Controller is $1199. Although these prices may seem high to many consumers, it's important to keep in mind that each ZonePlayer is, as mentioned above, an integrated amplifier, wireless base station, and digital-to-analog converter in one small unit; $499 doesn't seem so steep when you consider how much it would cost to buy similar components separately. It's also helpful to put the Digital Music System in context—it's designed to replace multi-room, built-in audio systems that often cost upwards of $10,000 for multiple rooms. For a budget of $2600 plus speakers, you can provide custom audio to four rooms with two Controllers.

Another way to look at the value of the Digital Music System is to consider what you would need to purchase to get similar functionality using other products. For example, you could purchase several of Apple's AirPort Express units at $129 each to deliver audio to different rooms. But you'd also need to purchase stereo systems for each room, you couldn't listen to music in more than one room at once, and you wouldn't be able to view and control the music being played without purchasing a laptop. Slim Devices' Squeezebox units provide a small screen and remote control, as well as a "synchronized play" option, but you're still talking $280 for each Sqeezebox, plus you'd again need to buy a stereo for each room at a few hundred bucks (at least) a pop. That's about the same price as the Sonos with many of the other limitations of the AirPort Express system.

IA at 205.

My test setup included a ZP80 along with a pair of ZP100's (pictured at left), a C100, and a pair Sonos Speakers. I have also hooked up a pair of Carver HT5.1 bookshelf speakers to one ZP100 and an Altec Lansing self-powered satellite-subwoofer PC speaker system to the ZP80.

**Pricing: It Depends On Your Point Of View**

What's unique about the Sonos' pricing is that it is either extremely expensive or a significant bargain, depending on your point of view. The Sonos ZonePlayers are $499 each for the ZP100 (the one with a built-in amplifier) and $349 for a ZP80 (the one without the amplifier). ZoneControllers cost $399 each, speakers are $179, charging docks for the ZoneController are $49, and a spare charger cables is another $19. The least expensive bundle is $999, which will be fine for many users, but expects users to both BYOS and BYOA.

This pricing makes technical early adopters scratch their heads and whine that compared to most streaming audio players, the Sonos is wildly overpriced. The Omnifi Simplefi I've had in the house for a couple of years, along with products from Pinnacle, Roku, Squeezebox, Linksys, and Apple, all cost between $129 and $299. Other options are mating an iPod with an Apple, Klipsch, or Bose audio dock: presto! music wherever you are. Finally, a cheapskate friend pointed out that boomboxes cost $39 at Target and can also put music in your room. If you'd be happy with a boombox - or even an iPod and an Apple HiFi - then the Sonos is clearly too expensive.

At the other extreme, a custom installed system can cost tens of thousands of dollars for a multi-zone setup that would cost $3,000 or $4,000 with a Sonos. In this respect, the Sonos is an incredible bargain.

The problem with the iPod and boombox is that they are single zone solutions - when you leave that room, you leave your music (and the boombox will only be able to play a fraction of your music collection, digitized or not). True, you could put a speaker dock in every room of your house and move the iPod with you, and if you live alone, this is a perfectly valid solution, but even then you need to move the iPod every time you leave the room, and it's hardly sufficient for a party.

The problem with most streaming media players is that they are either single zone (Apple, Linksys), cannot selectively synchronize music among multiple zones (all but the Squeezebox), have no display for selecting music to play (Apple, Linksys), have only a basic user interface (all), require a reasonable level of comfort with technology for setup (all except the Apple), and cannot accept music from remote sources and stream that around (all).

IA at 227.

684. Millington discloses "synchrony groups," which correspond to the synchronization groups disclosed in Bose LifeStyle. Millington notes that "[a] user, using the user interface module 13, can enable a zone player 1 l(n) that is currently not a member of a synchrony group to join a synchrony group, *after which it will be enabled to play the audio program that is currently being played by that synchrony group*." Millington, 7(emphasis added); *see also id.* at 9 ("Contemporaneously, the zone player 1 l(n) can notify the master device of the synchrony group that it (that is, zone player 1 l(n)) is joining, after which the master device can begin transmission of audio information and timing information to that zone player 1 l(n). The zone player 1 l(n) can thereafter begin playback of the audio program defined by the audio information, in accordance with the timing information so that the zone player 1 l(n) will play the audio program in synchrony with the master device."); *id.* at 41 ("The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device."). Accordingly, Millington discloses that even when a zone player is added to a zone group (i.e., synchrony group), that it is only *enabled* to play the audio program playing in the synchrony group, but it does not necessarily play that audio immediately. Instead, the zone player must later transition to synchronous playback, as the claims require.

685. Further, as discussed above, a person of skill in the art would have been motivated to combine the Sonos System with Millington. They are both in the same field of endeavor—control of speaker systems, speaker groups, synchronous playback of speakers, and home audio systems—and they both describe the same features and devices (e.g., "zone players") in the same language. Further, a person of skill in the art looking to the Sonos System would have also reviewed materials authored by one of the engineers, like Mr. Millington, that was working on the

Sonos System to learn more about its capabilities.

686. Millington discloses "synchrony groups," which correspond to the zone groups disclosed in the Sonos System. Millington notes that "[a] user, using the user interface module 13, can enable a zone player 1 l(n) that is currently not a member of a synchrony group to join a synchrony group, *after which it will be enabled to play the audio program that is currently being played by that synchrony group*." 7 (emphasis added); *see also id.* at 9 ("Contemporaneously, the zone player 1 l(n) can notify the master device of the synchrony group that it (that is, zone player 1 l(n)) is joining, after which the master device can begin transmission of audio information and timing information to that zone player 1 l(n). The zone player 1 l(n) can thereafter begin playback of the audio program defined by the audio information, in accordance with the timing information so that the zone player 1 l(n) will play the audio program in synchrony with the master device."); *id.* at 41 ("The system is such that synchrony groups are created and destroyed dynamically, and in such a manner as to avoid requiring a dedicated device as the master device."). Accordingly, Millington discloses that even when a zone player is added to a zone group (i.e., synchrony group), that it is only *enabled* to play the audio program playing in the synchrony group, but it does not necessarily play that audio immediately. Instead, the zone player must later transition to synchronous playback, as the claims require.

687. Millington further discloses keeping a media player in standalone mode after joining a group, because players disclosed by Millington continue to operate independently of the newly joined group. __ ("As another possibility, the user may enable the zone player 11(1) to leave the synchrony group with zone player 11(2) and join the synchrony group with zone player 11(6). In connection with the last possibility, the zone player 11(1) can continue providing audio information from the audio information source 14(1)(1) to the zone player 11(2) for playback thereby.").

688. Millington discloses that speakers may be enabled to play back music in a group when they join that group, but do not necessarily do so. __ ("A user, using the user interface module 13, can enable a zone player 11(n) that is currently not a member of a synchrony group to join a synchrony group, after which it will be enabled to play the audio program that is currently being played by that synchrony group.").

1) Obviousness - Rajapakse

689. It would have been obvious to combine Rajapakse with Bose LifeStyle for the reasons discussed above. As discussed below, Rajapakse discloses this claim element.

690. Rajapakse discloses keeping speakers in a standalone mode. Rajapakse, 14:37-40 ("Also it is possible to have the media renderers in no specific zone, which can be considered as equivalent to the media renderers being in zone 0 or a default zone.").

691. Rajapakse discloses that after being added to a zone, the media renderer (speaker) may be playing or idle, so it may not be invoked by any zone (i.e., in standalone mode). Rajapakse, 7:52-56("The identity information includes the media renderer's identifier, its set of assigned zone identifiers (ZIDs), and its role within each zone, and known default stream identifiers for each zone. The current state information includes its current playing state: playing or idle."). Sonos described "standalone mode" this way in its summary judgment brief, as discussed above.

692. Rajapakse discloses dynamic grouping and transitioning speakers among groups. Rajapakse, 3:65-4:2 ("If the user and media source 101 move to the dining room that also has a set of destination devices 103 present, it is desirable for music playback from the media source 101 to transition to this new set of destination devices 103 automatically and without interruption.").

693. Rajapakse also discloses that the user may select which zone to invoke from many different zones. Rajapakse, 8:34-40 ("After zone manager discovery 602, the zone control point 209 retrieves zone information from each zone manager 210 and the zone control point 209 then

uses this information to select a zone from the available set of zones. This selection may be an auto selection from the available zones (ZIDs) based on some preset criteria, such as signal strength, or based on user selection. . . . This process allows the user and zone control point 209 to get information on the zone, view media available to play on the zone and then make a selection.").

694. Rajapakse discloses transitioning from one zone to another or transitioning from not playing music to playing music. Rajapakse, 8:67-9:2 ("If a new zone control point 209 requests the zone, the previous zone control point 209 can release the reservation.").

695. Rajapakse discloses transitioning from one zone manager to another. Rajapakse, 9:35-44("If a media renderer 203 is already registered with another zone manager when the registration request comes in, and the registration request passes authentication, before responding, the media renderer 203 will notify 707 its current zone manager of the registration request from the new zone manager and ask for permission to deregister. If the current zone manager does not respond to this deregistration request within a timeout period, the media renderer 203 will assume approval and accept the new registration request from the new zone manager.").

696. Rajapakse discloses forcing a transition of a media renderer from one zone to another. Rajapakse, 9:57-59 ("The user may, via the zone control point 209, cause the zone manager 210 to send a force registration 703 request to a media renderer.").

(x) *Limitation 1.9: "after the given one of the first and second zone scenes has been selected for invocation, receiving, from the network device over the data network, an instruction to operate in accordance with a given one of the first and second zone scenes respectively comprising a given one of the first and second predefined groupings of zone players; and"*

697. In my opinion, Bose Lifestyle discloses this claim limitation.

698. As described in the previous claim elements, and shown briefly below, a user may select a synchronization group for playback using the Room button, and use the playback controls to cause Bose LifeStyle to operate as a synchronous playback group.

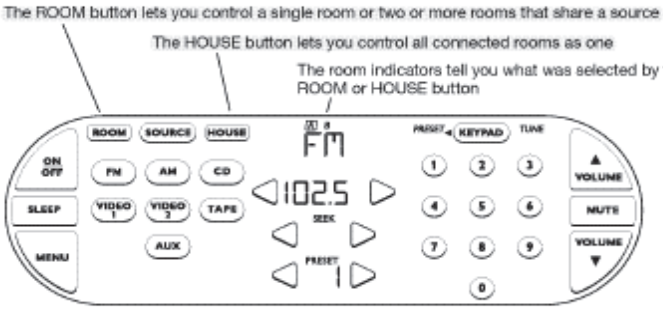


## Operating in more than one room

Your Lifestyle® 50 system can control up to four sets of Bose® powered speakers, allowing your family to enjoy different audio sources (CD, radio, TV, etc.) in up to four rooms. These rooms are referred to as room A, B, C, and D, with room A being the primary room (the one used for a one-room system). If two or more rooms are connected to your system, the Personal™ music center displays ROOM and HOUSE buttons, and room indicators (A, B, C, and/or D). Figure 48 shows an example display for a two-room system.

**Figure 48**

*Example display for a two-room system*




## Understanding the room indicators

- A boxed letter indicates the presently-selected room or rooms. The selected room is affected by any source changes, or any change you make using the VOLUME, MUTE, ON/OFF, or SLEEP buttons.
- B An unboxed letter indicates a room listening to a ***shared source***. A shared source is one that is playing in the controlled room as well as in up to three additional rooms. If you change the radio station, CD track, etc., of the shared source, the change affects all rooms sharing this source. However, you cannot change sources for all affected rooms at the same time. The VOLUME, MUTE, ON/OFF, and SLEEP buttons only affect the boxed room(s).
- An empty box appears for each connected room when you press the HOUSE button. When you change the volume in the HOUSE mode, the numerical level appearing on the display does not represent the actual volume level in all connected rooms. It only represents the actual volume in rooms represented by a boxed letter.





BOSE_SUB-00000043.

699. Further, Bose Link is used as protocol to communicate between and amongst the various zones in order to invoke, for example, the play command that simultaneously plays audio in multiple zones. More specifically, Bose Link in conjunction with the media center operates over a network and allows for a user's pre-defined zones to also play different audio in simultaneously.

PTSC

Company Confidential

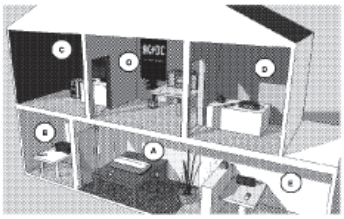
BOSE

**What is Bose Link?**

Bose link is a communication protocol. To communicate there must be at least two participants that speak the same language. To Bose products, Bose link is that language.

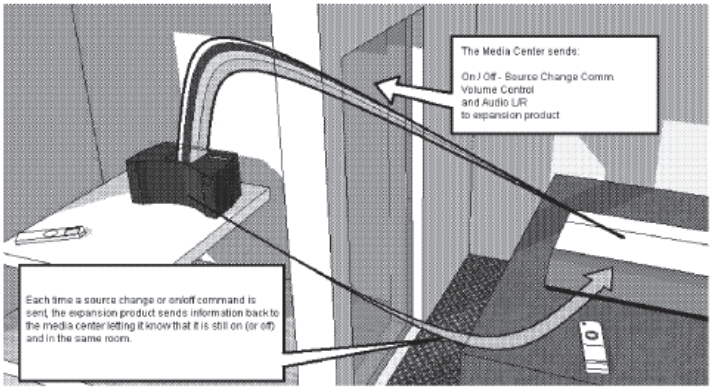
**Rooms**

There are 15 different rooms that can be controlled by a Bose link enabled media center. The main room – labeled room A – is reserved for the Lifestyle speaker components. The other rooms – rooms B-O – are reserved for expansion via Bose link.



For a Bose link setup to work the system must include a Bose link enabled media center (a controller), a Bose link expansion product, and an expansion remote control. Both the expansion product and the remote must be configured to operate on the same room.

A Bose link connection is essentially a conversation between the media center and the expansion device. The media center sends on/off, volume and source change commands along with audio to the expansion product. The expansion product responds by sending information back to the media center to let it know that it is still on (or off) and in the same room. This information exchange occurs each time a power or source change command is issued by the expansion remote.




When the media center receives an ON command from an expansion remote the system turns on and checks for any Bose link products that might be connected, but it will only look for Bose link products that are assigned to the same room as the remote.

Understanding Bose® link Page 2 of 8

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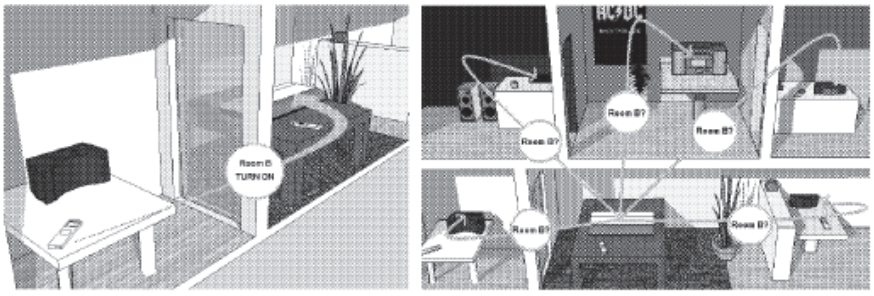
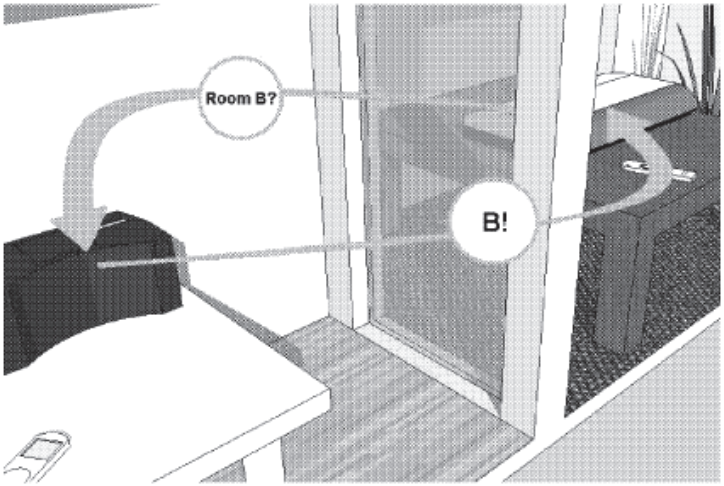
If the media center receives a command from a remote configured for room B, for example, the media center calls out to other Bose link products which might be assigned to room B. If a connected expansion product is assigned to room B it will respond to the media center and a Bose link connection will be made. The media center will not acknowledge a response from anything not assigned to room B.






The media center will not acknowledge more than one response from the same room, either. As with any productive conversation, there can only be one person speaking at a time. If more than one product is assigned to room B the media center won't know which one to listen to. If the media center can't understand the response from the expansion products, or if there is no response at all, the media center will turn itself off and the Bose link connection will not be successful.

Understanding Bose® link Page 3 of 8

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## Streams

A Bose link enabled media center is also capable of managing two separate sources at the same time. Each source can be sent to one of two different outputs - or 'streams' – within the Bose link connection. 4 of the 9 pins that make up the Bose link connection on the back of the media are responsible for delivering these streams – all of which are analog. Two pins are reserved for stream 1 audio L/R (fixed), and another two pins carry stream 2 audio L/R (fixed) – (there is another pair of pins that carry variable stream 2 audio that will be discussed later). Every Bose link expansion product has 2 inputs to accommodate each stream, and the remote control tells the device which stream to listen to. The expansion products receive fixed audio and then control volume via commands they receive from the media center carried on other pins.

**Here is an example:**
If an expansion remote configured for stream 1 sends an ON command to the media center, the media center will activate the pins that carry stream 1 information. The media center will also call out to any Bose link product set to the same room code as the remote. If the media center gets an answer it can understand, it will respond by telling the expansion product to turn on and listen to its stream 1 inputs. If the media center does not get a response from an expansion product set to the same room as the remote it will simply turn itself off.

The main room, or room A, can only operate on stream 1. Although any of the expansion rooms can be configured to operate on either stream 1 or stream 2, expansion rooms are generally assigned to stream 2. Since only one source can be sent to each stream at any given time, keeping Bose link expansion products on stream 2 prevents changes made in expansion rooms from affecting what is being played in the main room, and vice-versa.





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*(xi) Limitation 1.10: "based on the instruction, transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players such that the first zone player is configured to coordinate with at least one other zone player in the given one of the first and second predefined groupings of zone players over a data network in order to output media in synchrony with output of media by the at least one other zone player in the given one of the first and second predefined groupings of zone players."*

700. In my opinion, Bose LifeStyle discloses this claim limitation.

701. As described in the previous claim elements, a user may select a synchronization group for playback using the Player selector box, and use the playback controls to cause Bose LifeStyle to operate as a synchronous playback group.

## XI. INVALIDITY BASED ON SECTION 112

702. In my opinion, the specification of the '885 patent fails to convey with reasonable clarity to those skilled in the art that, as of the filing date, the named inventor was in possession of the invention. Sonos filed the application that led to the '885 Patent on April 12, 2019, but that patent application claims priority through a long chain of continuation applications back to a provisional application filed on September 12, 2006. In the intervening 13 years of patent prosecution, Sonos added new matter during the claim amendment process that was not originally disclosed.

703. In the original application, the claims related to configuring the zone scene. In the 2019 patent application, the claims cover an intricate set of instructions for putting particular "zone players" into particular "scenes" in a particular order. Claim 1 is set out below:

1. A first zone player comprising:

a network interface that is configured to communicatively couple the first zone player to at least one data network;

one or more processors;

a non-transitory computer-readable medium; and

program instructions stored on the non-transitory computer-readable medium that, when executed by the one or more processors, cause the first zone player to perform functions comprising:

while operating in a standalone mode in which the first zone player is configured to play back media individually in a networked media playback system comprising the first zone player and at least two other zone players:

(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked; and

(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player;

after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation;

after the given one of the first and second zone scenes has been selected for invocation, receiving, from the network device over the data network, an instruction to operate in accordance with a given one of the first and second zone scenes respectively comprising a given one of the first and second predefined groupings of zone players; and

based on the instruction, transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players such that the first zone player is configured to coordinate with at least one other zone player in the given one of the first and second predefined groupings of zone players over a data network in order to output media in synchrony with output of media by the at least one other zone player in the given one of the first and second predefined groupings of zone players.

704. Generally, the claim requires a first zone player to operate in "standalone mode" and play back media "individually." Then the first zone player is added to a zone scene including the first zone player and a second zone player. Then the first zone player is added to another zone scene, including the first zone player and a third zone player. Adding the first zone player to the two scenes does not change the first zone player from continuing to play back media individually until one of the zone scenes is "invoked," which causes the first zone player to "transition" from individually playing back media to playing back media as part of the invoked zone scene.

705. The specification never discloses this specific set of operations. Instead, the specification discloses a home audio system including "zone configurations," speaker groups, and "zone scenes." It does not describe how those limitations are combined, what happens when they are combined as set forth in the claim, or even whether zone scenes can include a shared zone player. A person of skill in the art reading the patent specification would not understand the patent to disclose this particular claimed set of operations.

706. First, the specification does not provide support for the claim limitation "a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players" because the specification never discloses that a zone player may be added to two zone scenes at the same time. The claims require that the first zone player is added to both a first and a second zone scene, but there is no description, or even an illustration, of adding a first zone player to two different scenes of zone players. Indeed, in the figures showing which zones can be added to a "zone configuration" or "scene," there is no disclosure of adding the same zone (e.g., bathroom) to multiple zone configurations or scenes. As shown below, in Figure 3A (from the original '206 Patent), the "zone configuration / scene" includes the bedroom, den, and dining room. The bedroom, den, and dining room are not included in any other zone

configurations or scenes.

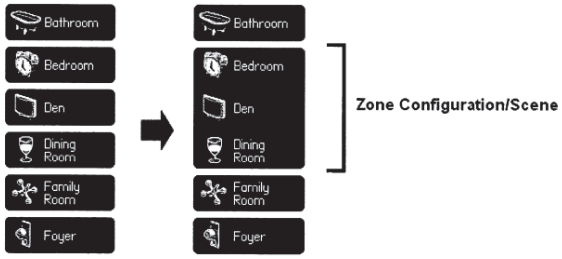



FIG. 3A

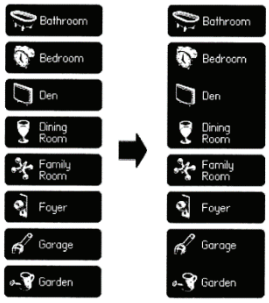



FIG. 3B

707. There are no embodiments disclosed in the specification showing a zone player included in more than one scene or even more than one group. While the figures above show including particular zones in a scene, there is only a single scene and as a result no overlap of zone players within multiple scenes. Nor would a person of ordinary skill in the art have understood the specification to contain an equivalent description.

708. The closest the specification comes to disclosing scenes with overlapping zone players is the following portion of the specification:

> In order to satisfy such requirements, two groups of audio players must be established. In the morning, the audio players in the bedroom, the bathroom and the den need to be grouped for the broadcast news. In the evening, the audio players in the den and the living room are grouped for the music. Over the weekend, the audio players in the den, the living room, and a kitchen are grouped for party music. Because the morning group, the evening group and the weekend group contain the den, it can be difficult for the traditional system to accommodate the requirement of dynamically managing the ad hoc creation and deletion of groups. '885 Pat. at 2:5-12.

709. But this disclosure actually teaches away from having scenes existing at the same

time with overlapping zone players. Rather, the specification teaches that the three groups exist at different times—one in the morning, one in the evening, and one over the weekend. The specification offers the solution that "[w]ith a minimum manipulation, the audio players may be readily grouped," but this does not disclose that speakers may belong to more than one group at any given time, and neither does the specification's generic recital that "there is a need to individually or systematically adjust the audio volume of the audio players." *Id.* at 2:18-20.

710. Second, the specification does not provide support for the claim limitations "continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation" and "transitioning from operating in the standalone mode to operating in accordance with the given one of the first and second predefined groupings of zone players." The specification provides no description or figures describing what happens when a speaker in "standalone mode" (a term never used in the specification) is added to multiple zone scenes and then one of those zone scenes is later invoked. Because the inventors did not contemplate having speakers in overlapping zone scenes, the specification does not disclose what might happen when a speaker playing back music individually is added to a zone scene. For example, the specification could have disclosed that the speaker begins playing back whatever music the zone scene requires when added to that scene, or it could have recited that the speaker discontinue playing any music when it is added to the zone scene, or it could have recited asking the user for guidance as to continue playing music or transitioning to whatever music is playing in the zone scene. Instead, the specification is completely barren on this issue. The closest disclosure in the specification is the following:

> upon the activation of a saved scene, the process 600 checks the status of the players associated with the scene. The status of the players means that each of the players shall be in condition to react in a synchronized manner. '885 Pat. at 10:56-58.

711. But this portion of the specification only discloses that upon "activation" of a scene,

the players are in condition to react in a synchronized manner. It does not describe the behavior of players when added to multiple scenes, and in particular it does not describe that players in "standalone" mode (which is never mentioned in the specification) continue as if they had not been added to any zone scene at all.

712. To the extent Sonos seeks to rely on the provisional application (SONOS-SVG2-00033730) for written description support, that too is insufficient. Although an "appendix" to the provisional application includes a section titled "What happens to the Music that's already playing when a Zone Scene is started," that section does ***not*** disclose the claimed method. SONOS-SVG2-00167534 at 537. Rather, the provisional appendix teaches that "if music is playing in one or more zones there are several possibilities (TBD)," showing that this was an issue the inventors considered but was still "to be determined" at the time of filing the application. *Id*. The three options discussed in that section for how to handle what happens to a player that is already playing music when a zone scene is started are different from what Sonos claimed some 16 years later when the '885 patent was modified during prosecution.

713. The first option given in the provisional appendix is that "the music will stop in any room that is part of the Zone Scene." *Id*. This is irrelevant because Sonos did not claim this option. The second option is that the "user gets to choose from which of the ;joining' [*sic*] Queues the new zone group should play." *Id*. Sonos did not claim this option either; in the claims, the user is not given any option as to what the zone scene should play. The third option given in the provisional appendix is that "[i]n the case where only one of the zones in the new group was playing music, the new group should take the music (and Queue) of that zone." *Id*. That too is different from what is claimed in the '885 Patent. The claims describe a situation where the newly-added zone player will continue playing music in standalone mode until it is overridden by an "invocation" of the zone scene. The claims do not cover the situation where only one of the zone players is playing

media and upon invocation of the zone scene all players start playing that same media.

714. The specification and provisional appendix at best disclose generic speaker grouping or how to handle particular (unclaimed) situations upon invoking a zone scene. The specification does not disclose the same solution that is claimed, and I understand that merely rendering the claimed solution obvious is insufficient.

715. [redacted]

716. [redacted]

*Id.* at 761 (highlighted).

717. [redacted]

718. Sonos responded in Reply to the evidence set forth above, and briefing from Google which I agree with and have adopted in part. Below I set forth Sonos's arguments (Dkt. 274 at 10-12) and my responses to those arguments.

719. Sonos makes five arguments that overlapping speaker groups were disclosed in the original '885 patent specification:

> First, the '885 Patent discloses that after one "zone scene" has been set up (i.e., created and saved), a user may "go back . . . to configure another [zone] scene if desired" – which conveys to a POSITA that any number of different "zone scenes"

can be set up for a given system and exist at the same time. See '885 Pat., FIG. 6, 10:51-52; Ex. R, ¶45.

Second, the '885 Patent discloses examples where multiple different "zone scenes" have been set up and are in existence at the same time. See, e.g., '885 Pat., FIG. 8 (disclosing "Wakeup" and "Garden Party" scenes that are in existence at the same time); see also id., 8:52-9:19 (disclosing four different examples of "zone scenes" for a given system); Ex. R, ¶46.

Third, the '885 Patent discloses that when a user is selecting which "zone players to add during setup of each "zone scene," the user is presented with "ALL the zones in the system, including the zones that are already grouped" – which conveys to a POSITA that each "zone scene" being set up can include any grouping of "zone players" in a multi-zone audio system, regardless of whether the "zone players" are included in any other "zone scenes" and thus that multiple "zone scenes" with one or more overlapping "zone players" can be set up and exist at the same time. See '885 Pat., 10:12-19; see also id., 10:4-6; 10:36-42; Ex. R, ¶47.

Fourth, in the discussion at 8:52 – 9:19, the '885 Patent discloses four different examples of "zone scenes" in a given system that have overlapping members:
- a first "zone scene" named "Morning" that comprises a predefined group of the Bedroom, Den, and Dining Room "zone players";
- a second "zone scene" named "Evening" that also comprises one predefined group of the Bedroom, Den, and Dining Room "zone players" (as well as another predefined group of the Garage and Garden "zone players");
- a third "zone scene" comprising one predefined group of "zone players" located "upstairs" and another predefined group of "zone players" located "downstairs" (at least one of which would include the Bedroom, Den, and/or Dining Room players); and
- a fourth "zone scene" that comprises a predefined group of "all zones" in the system, including the Bedroom, Den, and Dining Room "zone players." See also Ex. R, ¶48.

Fifth, the '885 Patent discloses that "various scenes may be saved in any of the [zone player] members in a group" – which conveys to a POSITA that each "zone player" can be included in multiple different "zone scenes" in existence at the same time. '885 Pat., 2:56-59; Ex. R, ¶49.

720. I disagree with Sonos's arguments. First, the disclosure from the specification that a user may "go back . . . to configure another [zone] scene if desired" does not indicate that a zone player is a member of multiple zone scenes. Second, any disclosure that "multiple different "zone scenes" have been set up and are in existence at the same time" likewise fails to disclose that any zone player is a member of more than one zone scene. Third, Sonos argues that "when a user is

selecting which 'zone players to add during setup of each 'zone scene,' the user is presented with 'ALL the zones in the system, including the zones that are already grouped,'" but this does not disclose a zone player as a member of multiple zone scenes either. While all of the options for zone players to add may be shown, this portion of the specification does not indicate that a zone player already a member of a zone scene would *continue* to be a member of the zone scene if it was selected for a new zone scene. Fourth, the examples given therein do not disclose a zone player that was currently a member of multiple zone scenes; rather, they simply disclose that there are different options for configuring zone scenes, potentially at different times or in different households. Fifth, although the specification discloses that "various scenes may be saved in any of the members in a group," this does not indicate that different scenes are stored in a single member of a group at the same time, nor that the zone player is a member of each of those different scenes, which may instead comprise zone player members that are not the zone player storing the zone scenes. Finally, to the extent that Sonos intends to rely on "the scenario discussed at 2:5-12, [where] a user could first set up three different "zone scenes" for the morning, evening, and weekend," this does not disclose simultaneous zone scenes because the zone scenes are named morning, evening, and weekend, indicating that the specification intended to disclose zone scenes for different (non-overlapping) times of day and the week.

721. Next, Sonos argues that there is support for the particular claimed order of operation, and makes four arguments in support:

> First, a POSITA would understand that the claimed "standalone mode in which the first zone player is configured to play back media individually" refers to a "zone player" operating in a non-grouped state in which it is configured to play back audio on its own, rather than as part of a group for synchronous playback. See Ex. R, ¶53. As explained above, the '885 Patent clearly discloses that "zone players" are capable of operating in such a "standalone mode." Supra II.B.i.; '885 Pat., 4:44-5:2, 5:21-6:27, 6:39-43; Ex. R, ¶39, 53.

Second, as explained in response to Google's first § 112 argument, the '885 Patent does disclose that a "zone player" can be added to multiple different "zone scenes." Supra II.B.ii.

Third, the '885 Patent discloses that a "zone scene" is a group of "zone players" that is "predefined" and "saved" for future use during a "setup" phase, but is not activated for synchronous playback at that time. Supra II.B.i; '885 Pat., 8:45-51, 10:4-19, 10:36-52, 11:12-19; D.I. 249-11, 1-2, 9-16; Ex. R, ¶55. Rather, the predefined group of "zone players" initially exists in an inactive state, which is what the '885 Patent explains when distinguishing a "zone scene" from an ad-hoc group that is automatically activated at the time it is formed rather than being predefined and saved for future use. Id. In this respect, the '885 Patent discloses that, unlike for an ad-hoc group, the act of adding "zone players" to a "zone scene" does not cause those "zone players" to become linked together for synchronous playback at that time. Ex. R, ¶53. This conveys to a POSITA that a "zone player" operating in "standalone mode" prior to being added to each new "zone scene" will continue to operate in "standalone mode" after being added to each new "zone scene." Id.

Fourth, the '885 Patent discloses that the subsequent act of "invoking" a "zone scene" is what activates the "zone scene" for synchronous playback by causing the "zone players" in the invoked "zone scene" to become configured to play audio in synchrony in accordance with a given "zone scene." Supra II.B.i; '885 Pat., 9:16-20, 10:53-63; Ex. R, ¶56.

722. I disagree with Sonos's arguments. First, Sonos argues that the specification "clearly" discloses speakers playing back media in standalone mode, but the portions of the specification cited—'885 Pat., 4:44-5:2, 5:21-6:27, 6:39-43—do not clearly disclose such a standalone mode. Second, I already addressed above that the patent does not disclose adding a zone player to multiple zone scenes. Third, Sonos argues that the specification discloses having "zone players" initially exist in an inactive state, but this is not disclosed in the specification. See '885 Pat., 8:45-51, 10:4-19, 10:36-52, 11:12-19. Those portions of the specification instead disclose ordinary usage of a zone player rather than different "states." Further, the specification never distinguishes "zone scenes" from "ad hoc groups" by stating that the "ad hoc group" is automatically activated at the time it is formed. Rather, the specification teaches that ad hoc groups may need to be re-formed over time. Sonos concludes that a POSITA would understand based on these portions of the specification that zone players in standalone mode would continue operating

in standalone mode after being added to a new zone scene, but Sonos cites no direct evidence of this, and instead makes this conclusion from a set of incorrect interpretations of irrelevant portions of the specification. Fourth, Sonos argues that "invoking" a zone scene causes the zone scene to become configured to play audio in synchrony, but this does not disclose that a zone player continues in standalone mode after being added to a group either. Rather, the zone player may have been stopped and then later invoked to play back the different audio in synchrony.

## XII. NON-INFRINGING ALTERNATIVES

723. As I will explain (in what I expect will be my forthcoming report on non-infringement), Google's products do not infringe the '885 patent. It is thus my opinion that the accused Google products are themselves non-infringing alternatives to Claim 1 of the '885 patent.

724. Additionally, I understand that Sonos contends that for Claim 1 of the '885 patent, the date of first infringement in this case is November 24, 2020, the date on which the '885 patent issued. Based on my current understanding of Sonos's infringement contentions and my review of the evidence in this case, including documents, deposition testimony and source code, it is my opinion that additional non-infringing alternatives were available at the time of the alleged first infringement (and are still available today).

725. I discuss one of these non-infringing alternatives below. I reserve the right to update, amend, or supplement my opinions based on further evidence offered by the parties or located based on my investigation, opinions proffered by Sonos's experts, or arguments raised by counsel.

726. I describe an Alternative, an implementation in which when the accused "standalone" speaker is added to a target group, it matches the music (or silence) of the target group. The Alternative is a non-infringing alternative for the Accused Instrumentalities to the alleged invention claimed in Claim 1 of the '885 patent.

727. Claim 1 includes limitations that require the zone player to be added to two different zone scenes: "(i) receiving, from a network device over a data network, a first indication that the first zone player has been added to a first zone scene comprising a first predefined grouping of zone players including at least the first zone player and a second zone player that are to be configured for synchronous playback of media when the first zone scene is invoked" and "(ii) receiving, from the network device over the data network, a second indication that the first zone player has been added to a second zone scene comprising a second predefined grouping of zone players including at least the first zone player and a third zone player that are to be configured for synchronous playback of media when the second zone scene is invoked, wherein the second zone player is different than the third zone player". The claim then requires that "after receiving the first and second indications, continuing to operate in the standalone mode until a given one of the first and second zone scenes has been selected for invocation." In other words, the claim requires the a zone player that was playing back music individually to be added to two different zone scenes, but to continue to operate in a "standalone mode" until one of the two zone scenes is "invoked."

728. Infringement may therefore be avoided simply by having the "standalone" speaker that is added to two zone scenes ***not*** continue to operate in "standalone" mode after it has been added to those zone scenes. As noted above, instead, the accused "standalone" speaker after being added to a zone scene may match the music (or silence) of the target zone scene. Indeed, currently, when a single speaker is playing music and a group is playing music and the single speaker is added to the group, the speaker will begin playing the music that the group was playing. Having this be true for the situation where a speaker is playing music and joined to a group that is not playing music would harmonize the behavior in these two situations.

729. The Alternative would have been an available option for Google to implement at the time of the alleged first infringement and would take little engineering time and cost to

implement. Further, end users would have found Alternative #1 to be an acceptable alternative. It may match user expectations that a speaker added to a group playing music would take on playing the music (or silence) of that group. Indeed, this may be why Sonos has never implemented this claimed feature, and why Mr. Lambourne, the inventor of the '885 patent, testified that a purpose of the zone scene patents was to have synchronous audio playback for groups—not having synchronous audio playback of *some* members of the group while "standalone" speakers play back different/non-synchronous audio. Lambourne Dep. Tr. 57:14-59:3.

730. I have spoken to Mr. Ken Mackay, a software engineer for Google, regarding the Alternative on June 21, 2022. Mr. Mackay confirmed that to implement the Alternative, Google would only need only one Level-6 software engineer working for one day. Based on my education, my experience, the computer science projects I have supervised as a professor, my consulting experience, relevant deposition transcripts, my discussions with Mr. Mackay and my use of Accused Products, I estimate that the Alternative could be implemented in the accused products using the same engineering resources estimated by Mr. Mackay.

## XIII. UNPATENTABLE SUBJECT MATTER

731. As an initial matter, I understand that claim 1 of the '885 patent is directed to the abstract idea of grouping and controlling speakers through "zone scenes" that are created using subjective mental processes of human users. At base, the apparent invention according to the patent itself is grouping speakers for simultaneous playback of the same media. '885 Patent at 2:36-37 ("[T]he present invention pertains to controlling a plurality of multimedia 23 players, or simply players, in groups."). As the patent recognizes, "conventional multi-zone audio system[ s] that usually include[] a number of audio players" were already known art and could "play[] different audio sources in different audio players" by being "either hard-wired or controlled by a pre-configured and pre-programmed controller." Dkt. 208-2 at 1:62-65. In fact, the specification

expressly discusses how a person could already manually group speakers in his or her bedroom, bathroom, and den to listen to the news via radio while preparing for work in the morning, change the group to the speakers in his or her den and living room to listen to music in the evening, and then manually change the group once again to the speakers in the den, living room, and kitchen for party music on the weekends. *Id*. at 1:67-2:17

732. Claim 1 does nothing more than computerizing these well-known (and age-old) speaker groups. According to the specification's repeated discussion of the issue, the inconvenience of manually changing speaker groups was the very problem the patent was intended to address. *See, e.g*., Dkt. 208-2 at 2:20-24 ("In a traditional multi-zone audio system, the audio players have to be adjusted one at a time, resulting in an inconvenient and non-homogenous audio environment."); *id*. at 2:13-17 ("Because the morning group, the evening group and the weekend group contain the den, it can be difficult for the traditional system to accommodate the requirement of dynamically managing the ad hoc creation and deletion of groups."). The focus of claim 1 is not any specific improvement to computer technology for grouping speakers, but rather the use of computers to conserve human resources by automating work otherwise performed through human labor.

733. No new and/or unconventional solution is found in claim 1 and its "zone scenes." At best claim 1 also merely describes a system in functional terms, but provides no information on how these functions are performed. Claim 1 is devoid of any description for making a "new" zoning system. It merely recites an apparatus and method in the form of "receiving" a first indication of being added to a first zone scene, "receiving" a second indication of being added to a second zone scene, "continuing to operate in the standalone mode," "receiving" an instruction to operate in accordance with the first or second zone scene, and "transitioning from operating in the standalone mode to operating in accordance with" either the first or second predefined zone scene

groupings. I understand that Sonos accuses subjective mental processes of meeting the alleged "zone scene" point of novelty, which is another reason why claim 1 lacks any specificity or information about how the claimed functions are performed.

734. Claim 1 also does not recite any elements that I would regard as an inventive concept. Beyond what I mentioned above, the remainder of claim 1 recites only generic computer components-including processors, such a "non-transitory computer-readable medium," program instructions, and "players," performing their routine and conventional functions. I understand that Sonos focuses on the specification's discussion of adding standalone speakers to existing speaker groups, "dynamically" changing those groupings (Dkt. 208-2 at 2:14-19) and "sav[ing]" "predefined groupings" of speakers (*id*. at 10:36-45), but those concepts are not recited in claim 1, and are natural consequences of adding computerized and wireless technology to conventional speaker groupings. Adding wireless connectivity, another well-known concept at the time of the invention, leads to the precisely the same result. Whereas conventional speaker systems would need to be plugged into a different arrangement to change the composition of speaker groups, generic wireless communications allow rearranging to happen "dynamically" and in an "ad hoc" manner.

735. Sonos did not contribute any inventive concept beyond adding wireless communications and generic computer functionality to conventional speaker systems. Claim 1 does not set forth any particular physical configuration beyond generic devices communicating with each other. Indeed, as early as 2003, it was already "conventional" to have distributed home audio systems that were either single-source in which the same music is sent to multiple speakers in multiple rooms, or multi-source, in which different rooms can simultaneously access different music. *See e.g.*, Ex. 3 (SONOS-SVG2-00042661) at 677. Much like Sonos's supposed invention, these systems could "send fully digital audio throughout the home" and "allow[ed] people to listen

to different music in different rooms." *Id*. Those conventional systems "included programmable graphical displays" that could be handheld or wall-mounted. *Id*. at 678. The identified missing feature from these "conventional" systems was wireless capability and not being "designed to support digital music." *Id*. at 679. But wireless capability is not required by Claim 1 and the conversion of conventional analog systems to digital was not inventive in itself. I incorporate my discussion of the prior art references disclosing this well understood routine and conventional technology from Sections VIII and X herein, which in my opinion further demonstrate that Claim 1 recites a generic arrangement of known, conventional components.

## XIV. SECONDARY CONSIDERATION OF NON-OBVIOUSNESS

736. I have not seen any "secondary considerations" that may be used to demonstrate non-obviousness, or that would overcome the strong showing of obviousness based set forth above.

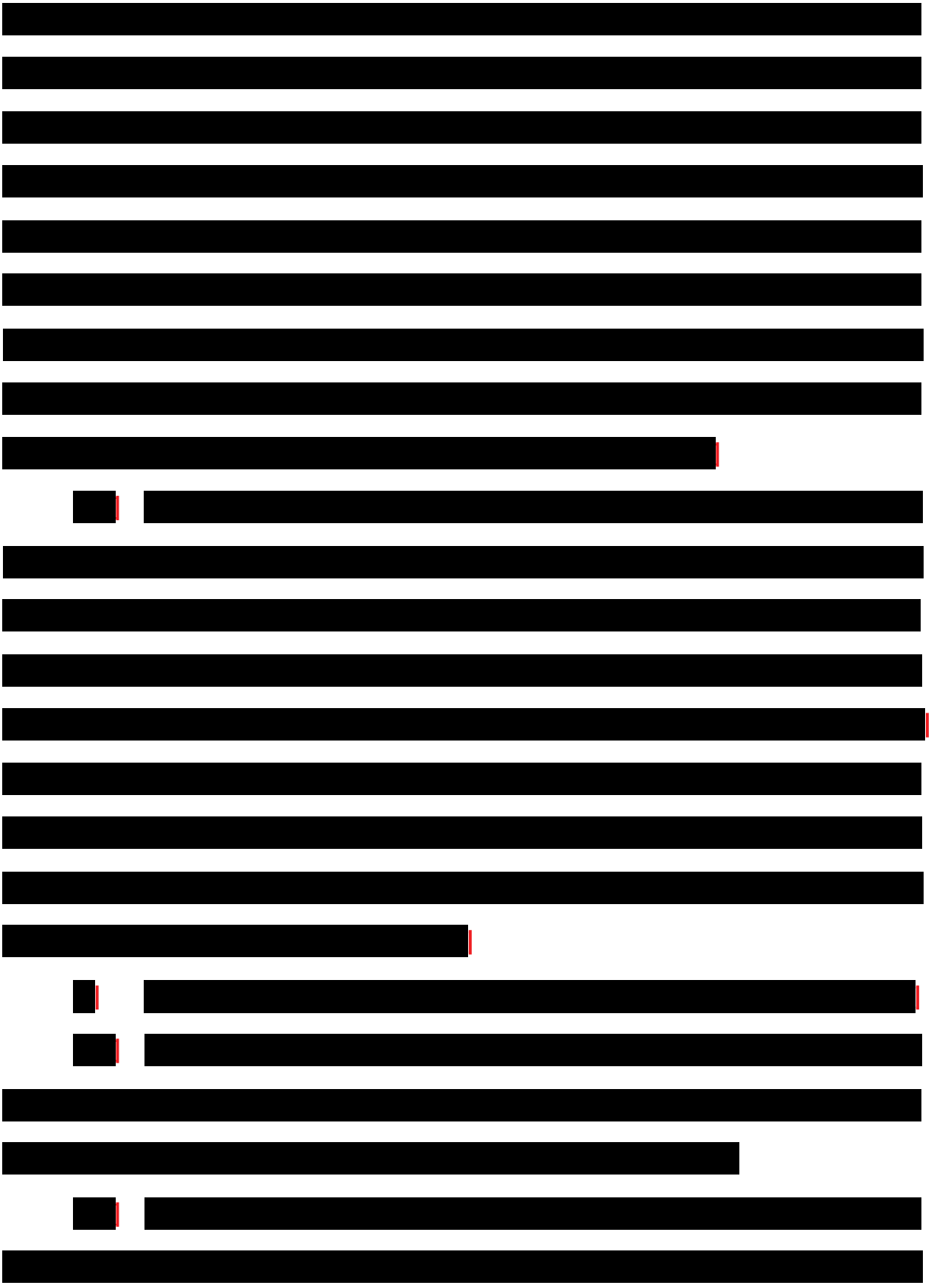
737. I understand that in response to Google's Interrogatory No. 4, asking Sonos to provide its contentions regarding secondary considerations, Sonos alleged that there was evidence of industry praise. I understand that to show "praise by others" there must be a nexus between the industry praise and the patented technology. Sonos points only to statements about GPM and YouTube Music; these products do not embody the patents. Moreover, the comments Sonos points to do not praise the claimed approach and only discuss music playback at a high-level. They do not track nor identify the claimed "standalone mode," "transition," "zone scene," joining speakers to multiple groups, or any of the other specific claimed features. As such, there is no nexus between any secondary consideration regarding praise and the claimed invention.

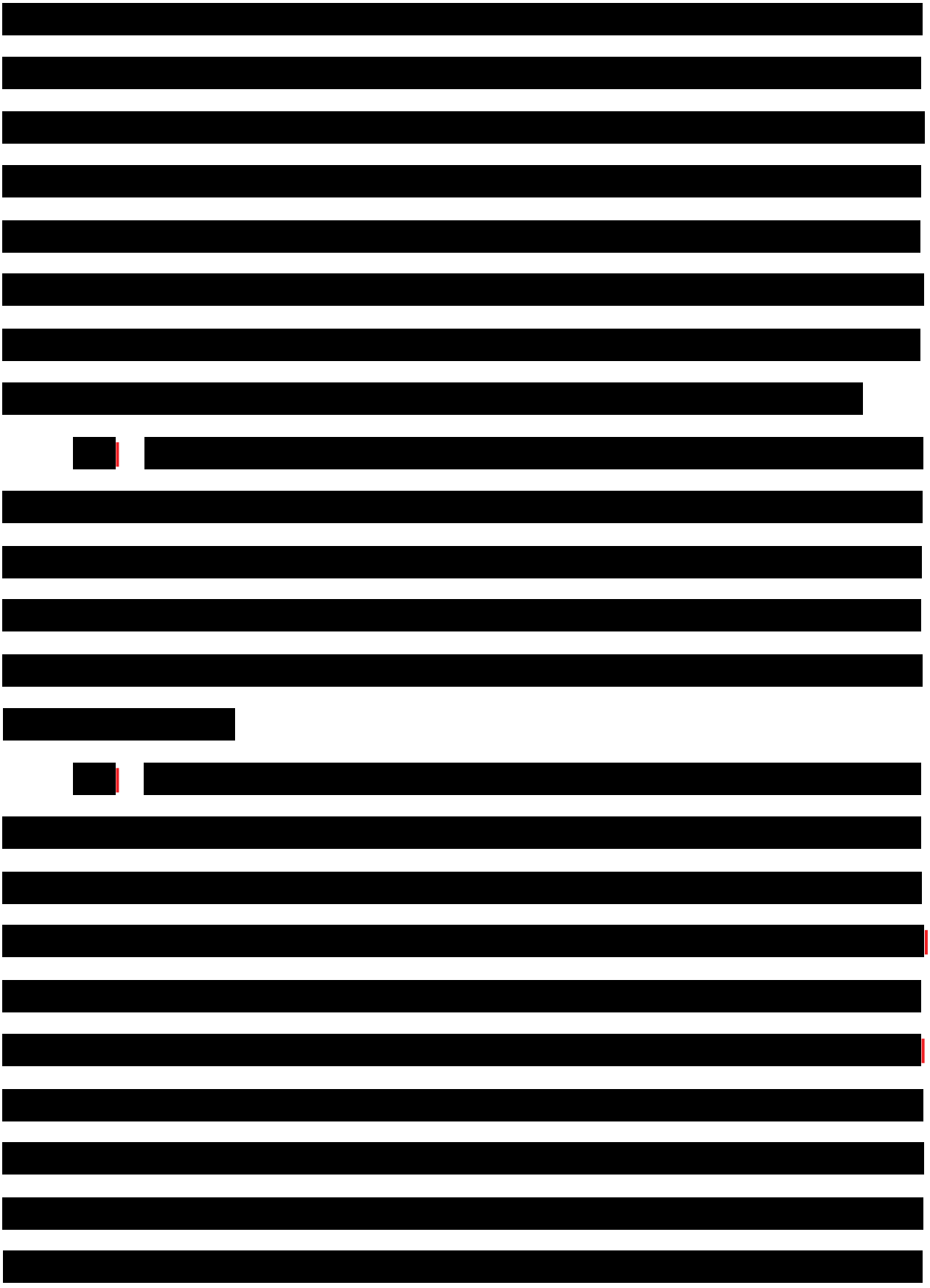
738. Sonos also identifies what it considers "skepticism" of the alleged invention in the '885 patent. Once again, Sonos does not identify any evidence that tracks or identifies the claimed "standalone mode," "transition," "zone scene," joining speakers to multiple groups, or any of the other specific claimed features. As such, there is no nexus between any secondary consideration

regarding skepticism and the claimed invention. Further, the "skepticism" Sonos identifies comes only from employees *at Sonos* and therefore is not industry skepticism or even third party skepticism. Nor does the evidence Sonos cite include a showing of technical infeasibility or manufacturing uncertainty. Merely recognizing that zone groups were "complex" and that Sonos would need to make the UI simple do not suffice to show skepticism, particularly given that Sonos has admitted that its own products do not practice the claimed inventions. As a result, any discussion of Sonos's own products cannot support the finding of a nexus to the invention.

## XV. COMPARABLE LICENSES AND PATENTS

[redacted]





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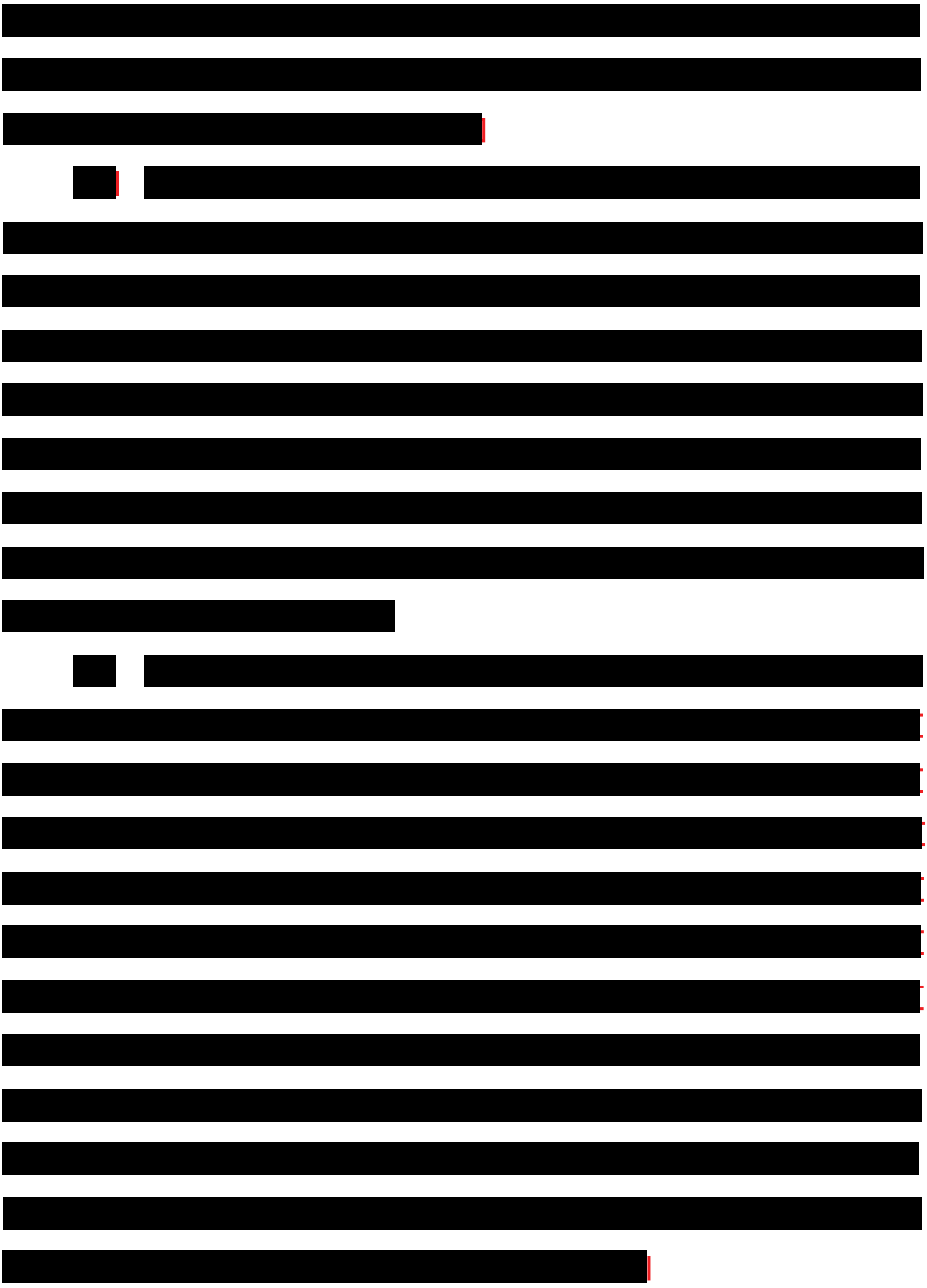

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## XVI. RESERVATION OF RIGHTS

755. In the event I am called upon to testify as an expert witness in this case, I may also discuss my own work, teaching, and publications in the field, and knowledge of the state of the art in the relevant time period. I may rely on handbooks, textbooks, technical literature, my own personal experience in the field, and other relevant materials or information to demonstrate the state of the art in the relevant period and the evolution of relevant technologies. I also reserve the right to rely on demonstrative exhibits to help explain the opinions set forth in this report.

756. I reserve the right to modify or supplement my opinions, as well as the basis for my opinions, in light of new positions set forth by Sonos, to the extent Sonos is permitted to advance those positions. This includes positions concerning the scope and interpretation of the asserted claim, infringement allegations, conception, diligence, and reduction to practice, and secondary considerations. It is also my understanding that Sonos may submit an expert report corresponding to this Report. I reserve the right to rebut any positions taken in that report.

I, Dan Schonfeld, declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

DATED: June 22, 2022

Dan Schonfeld

Dan Schonfeld, Ph.D